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Ethnomedicinal plants used to treat skin diseases by Tharu community of district Udham Singh Nagar, Uttarakhand, India

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ABSTRACT

Ethnopharmacological relevance: Tharu community is the largest primitive indigenous community of the Uttarakhand, India. In this article we have scientifically enumerated medicinal plants and herbal preparations used by the Tharu community to treat various skin diseases, and discussed dermatological properties of these plants in the light of previous ethnomedicinal, microbiological, pharmacological, toxicological, phytochemical and clinical studies.

Materials and methods: Ethnomedicinal survey was conducted in different villages of Tharu community located in district Udham Singh Nagar, Uttarakhand, India. Ethnomedicinal information on plants used to treat various skin diseases was collected from 122 individuals (93 males and 29 females), including 35 experienced herbal practitioners and 87 local villagers. For each of the recorded plant species the use value (*UV*) and fidelity level (*FL*) was calculated. The informant consensus factor (F_{ic}) was also calculated to find out the homogeneity in the information given by the informants.

Results: A total of 90 plant species belonging to 86 genera and 48 families were used by the Tharu community to treat various skin diseases *viz*., wounds (38 spp.), boils (32 spp.), cuts (18 spp.), leprosy (11 spp.), eczema (10 spp.), itching (7 spp.), ringworm (5 spp.), burns (4 spp.), leucoderma (4 spp.), cracked heels (2 spp.), dandruff (3 spp.), body infection (2 spp.), chilblains (2 spp.), hair fall (2 spp.) and toes infection (2 spp.). Information on botanical name, family, vernacular name, ailments treated, mode and dose of herbal preparations, *UV* and *FL* values are provided for each of the recorded species. According to *UV* value most preferred plant species used to treat skin diseases by Tharu community was *Ricinus communis* L. followed by *Tridax procumbens* (L.) L., *Azadirachta indica* A. Juss., *Ageratum conyzoides* and *Allium cepa* L.

Conclusions: The present study has revealed significant information on various medicinal plants used to treat skin diseases by Tharu community. Literature review has confirmed most of the claims made by the Tharu community regarding treatment of various skin diseases by the reported plants. The literature review has also revealed that products from very few of the reported plants are available in market, while most of the reported plants are still under preclinical or clinical trials. There are various known phytochemicals, and antibiotic, antibacterial, antiviral and antifungal agents present in these plants

Abbreviations: AAPE, arachidonic acid (AA) induced paw edema model; ABTS, 2,2′-azino-bis(3-ethylbenzothiazoline-6-sulfonic acid) assay; AIA, anti-inflammatory activity; AOTS, acute oral toxicity study; APE, adjuvant induced paw edema model; BKPE, Bradykinin induced paw edema model; BWM, burn wound model; C, cultivated; CAP, carrageenan air pouch model; CFAA, complete Freund's adjuvant (CFA) induced arthritis model; CHG, chlorhexidine gluconate; CIP, carrageenan induced peritonitis model; CODE, croton oil induced dermatitis of the mouse ear model; CPE, carrageenan induced paw edema model; CPG, cotton pellet granuloma model; CTS, chronic toxicity study; DPE, dextran induced paw edema model; DPPH, 2,2-diphenyl-1-picrylhydrazyl assay; DSW, dead space wound model; DXM, dexamethasone; EWM, excision wound model; F_{ic}, consensus factor; FL, Fidelity level; FoPE, formaldehyde induced paw edema model; FPE, formaline induced paw edema model; FRA, framycetin; FRAP, ferric reducing antioxidant powder assay; FSC, framycetine sulfate cream; H, herb; HPE, histamine induced paw edema model; HRBC, human blood cell membrane stabilization method; HTPE, 5-hydroxytryptamine induced paw edema model; IPE, immunologically induced paw edema model; IWM, incision wound model; KPE, kaolin induced paw edema model; LPE, leukotriene induced paw edema model; NA, not available; NEO, neosporin; NFZ, nitrofurazone; NPE, nystatin induced paw edema model; NT/NM, non-toxic/no mortality; PAPE, phlogistic agents induced paw edema model; PGNIN, peptidoglycan (PGN) induced inflammatory reaction; PGPE, prostaglandin E2 induced paw edema model; PIW, punch incision wound model; PPCIN, polyinosinic: polycytidylic acid (polyI:C) induced inflammatory reaction; PVI, povidone iodine ointment; RP, reducing power; S, shrub; SATS, sub acute toxicity study; SOF, soframycin; SPE, serotonin induced paw edema model; SSD, silver sulphadiazine; ST, sulphathiazole; TAC, total antioxidant capacity; TC, number of times cited in the reviewed literature to treat any skin disease in India; TPAPE, tetradecanoylphorbol acetate (TPA) induced paw edema model; Tr, tree; *UV*, use value; W & C, both wild as well as cultivated; W, wild; XEE, xylene induced ear edema model; ZNO, zinc oxide

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which may be synthesized or transformed to make pharmaceuticals. Some of the reported plants have shown promising results in preclinical trails and there is a need of clinical trials to see their safety and efficacy in treating various skin diseases. These plants may be targeted for development of new medicines, ointments or drugs for the treatment of skin diseases. However further toxicological, preclinical and clinical studies are needed to validate claims about little worked out plant species reported in the present study *viz*., *Sida cordata* (Burm. F.) Borss. Waalk., *Millettia extensa* (Benth.) Baker, *Caesulia axillaris* Roxb., *Ehretia laevis* Roxb., *Vanda tessellate* (Roxb.) Hook. Ex G.Don. and *Eualaliopsis binata* (Retz.) C.E. Hubb. Further studies on these plants are recommended to assess their potential in development of new skin care products.

1. Introduction

The human skin is the outer covering of the body that provides contact with the environment and protects human body from unfavorable external factors. According to Grice et al. (2009), "Human skin is a large, heterogenous organ that protects the body from pathogens while sustaining microorganisms that influence human health". Skin ailments affect people of all sex and ages, right from the neonate to the elderly stage, causing harm to human health in number of ways. It has been estimated that skin diseases amount to as high as 34% of all occupational diseases (Spiewak, 2000; Abbasi et al., 2010a). It is supposed to be the most common ailment amongst rural population (Policepatel and Manikrao, 2013). Skin diseases or infectious dermatological conditions are common in tropical countries where most of the population live in underdeveloped areas with lack of sanitation and inattentiveness to hygienic food habits. Skin diseases such as ringworm, itching, wound, skin disorders, leprosy, dermatitis, skin allergy, eczema, psoriasis, scabies and swelling are caused by a variety of micro-organisms and uncomfortable environment (Suresh et al., 2012). Traditional herbal medicines have played an important role in the management of dermatological conditions (Saikia et al., 2006). Hundreds of medicinal plants worldwide are used in the traditional medicine for treatment of skin diseases caused by bacteria, fungi and viruses (Kumar and Vidyasagar, 2008).

Uttarakhand Himalaya is a rich reservoir of biodiversity including enormous plants species and wildlife. It is a house to many indigenous communities like Bhotias, Boxas, Gujjars, Tharus, Rajis and Jaunsaries, who have excellent traditional knowledge on medicinal plants used to treat various human health problems. Apart from these, many other forest dwelling communities and local people also possess unique knowledge on uses of medicinal plants available in the region. Several researchers have documented ethnomedicinal plants used for treating various human health related ailments by different indigenous communities in sub-Himalayan region of Uttarakhand (Gaur, 1999; Gaur et al., 2010; Gaur and Sharma, 2011; Sharma and Painuli, 2011; J. Sharma et al., 2012; Sharma et al., 2013a, 2013b; Gairola et al., 2013). Although, Tharu community is the largest primitive indigenous community of the Uttarakhand, but very little information is available about ethnomedicinal plants used by this community. Recently J. Sharma et al. (2011, 2012) and Sharma et al. (2013b) have recorded some ethnomedicinal information on plants used by Tharu community to treat some general diseases, jaundice and epilepsy, respectively. But information about plants used to treat various skin diseases by Tharu community of Udham Singh Nagar is almost lacking except some preliminary information recorded by J. Sharma et al. (2011) about plants used to treat wounds (10 plants) and cuts (2 plants). Therefore, it was realised that the documentation of ethnomedicinal knowledge of this community is required. Keeping the aforesaid facts in view, the present study was undertaken to scientifically enumerate medicinal plants and herbal preparations used by Tharu community to treat various skin diseases, and discuss dermatological properties of these plants in the light of previous ethnomedicinal, microbiological, pharmacological, toxicological, phytochemical and clinical studies.

2. Research strategy and methods

2.1. Study area

The Uttarakhand state is situated in the northern part of India between 28°43′ and 31°28′N latitude and 77°34′ and 81°03′E longitude, and shares an international boundary with Tibet Autonomous Region in the north and Nepal in the east (Fig. 1). It embodies mountainous terrain ranging from 300 to 7800 m asl and has a geographic area of 53,483 km^2, which is even bigger in size than nearby Himalayan country of Bhutan. The state has very rich biological wealth and cultural heritage, and because of its unique geography and diverse climatic conditions it possesses the large number of medicinal plant species. Majority of the land area in Uttarakhand is mountainous (93%) and 64.79% area is covered by the forests (FSI, 2011). The present study was conducted in different villages inhabited by Tharu community in district Udham Singh Nagar of Uttarakhand, popularly known as the "Gateway to Kumaon hills". There are three main sub-divisions of Udham Singh Nagar – Rudrapur, Kashipur and Khatima. The district consists of seven tehsils *viz*., Bajpur, Gadarpur, Jaspur, Kashipur, Kichha, Khatima and Sitarganj. District is located in the Terai region and is endowed with a very rich fertile land. Agriculture is the mainstay and there are several agriculture related activities and industries located here. It is surrounded by Nainital district in the north, Bijnour, Moradabad and Rampur in the west, Bareilly and Pilibhit in the south and district Champawat in the east. It also shares south east boundary with the international border of the Nepal. Reserved forest area lies at the borders of district Nainital and Champawat. The villages visited in district Udham Singh Nagar to collect ethnomedicinal information were Bawanpuri, Beeriya, Bhagora, Bhagori, Bharuni, Bidora–Majola, Chamarpur, Chaumela, Dhohra–Pajaniya, Enjania, Gaganpur, Gaurikheda, Ghosari, Harriaya, Karkata, Kharoona, Khujri, Kicha, Lamkhera, Lauka, Magarsanda, Malara, Nadai, Nakulia–Bithora, Paseni, Sadhunagar, Sehjani, Sisalkhera, Sisoona, Sitargang, Taumala, Tisoor and Tukari–Bichua.

2.2. Studied community and ethnomedicinal survey

Frequent field trips were undertaken in different seasons *viz*., winter (November–March), summer (April–June) and rainy (July–October) in order to collect information on ethnomedicinal plants used to treat various skin diseases by Tharu community. Tharu community is the largest primitive indigenous community of the Uttarakhand, who lives in interior forests sustaining a close association with their ambient environment. They are shy and relatively timid people due to lack of exposure outside their community. Tharus have Mongoloid facial features and a unique

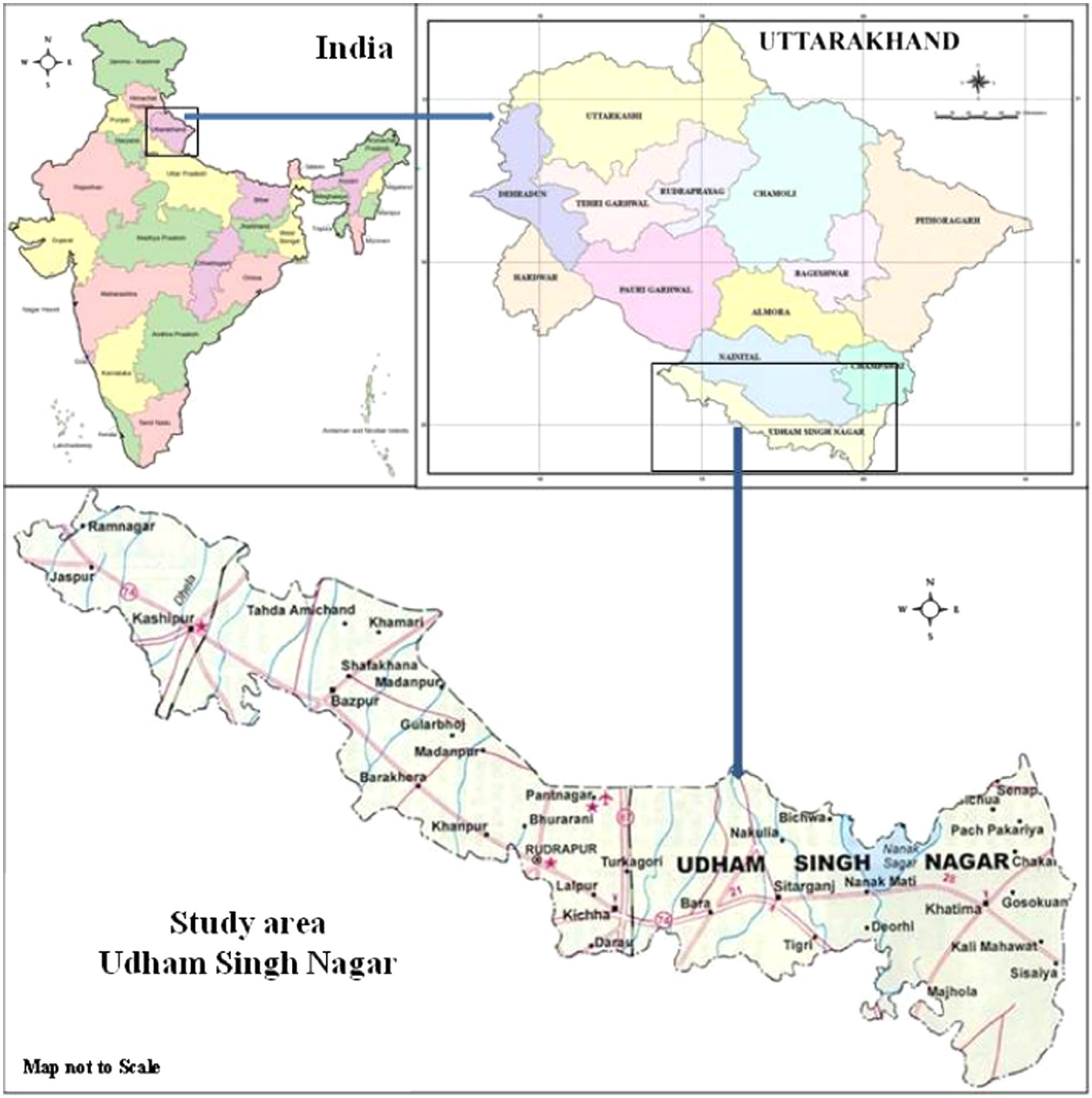

Fig. 1. Map of the study area.

dialect. According to some people, the word "*Tharu*" is derived from "*Taru*" which means trees or forest, as these people generally reside in forests. Whereas, according to others the word "*Tharu*" is derived from Sanskrit word "*Thal*" (ground), as they are settled in the forest ground in the terai region. According to Crooke (1896), one of the Kshatriya kings of plain named these people "*Tharu*" (wine bibber) because of their drunken habit. The main occupation of Tharu people is agriculture. Extraction of fibers and threshing of crops is common among these people. The social life style patterns of Tharus are similar in many ways with nearby Hindu societies. They follow Hinduism religion and worship all the Hindu God and Goddess. Besides that, they also worship the tribal God or indigenous deities such as "*Bhumisen Devta*" or "*Bhumsen*", "*Bhuniya*" and others. The Tharu community has a strong belief in witchcraft (*Jhar-phoonk* and *Tantra-mantra*). A local doctor or Vaidhya, locally known as "*Bharara*" or "*Bharra*" is found in each village. These medicinal practitioners have very good knowledge of traditional herbal therapies and village folk rely on them for recovering from diseases.

Ethnomedicinal information on plants used to treat various skin diseases was collected from 122 individuals (93 males and 29 females), including 35 experienced herbal practitioners and 87 local villagers. Verbal consent from the participants was taken and they were clearly informed about the objective of the study and their right to withdraw from the study at any time. Participants were specifically asked about plants and plant parts used for the

treatment of various skin diseases along with method of preparation and mode of administration of the prescribed medicine. Interviews were conducted in local language and according to symptoms described by participants, the skin diseases were classified in to 15 categories *viz*., boils, cuts, leprosy, eczema, itching, ringworm, burns, leucoderma, cracked heels, dandruff, body infection, chilblains, hair fall, toes infection and wounds.

The plant specimens were identified with the help of Flora of the District Garhwal North West Himalaya (Gaur, 1999). For the confirmation of identification the specimens were compared with the authentic specimens lodged at Herbaria of HNB Garhwal University Srinagar (GUH), Botanical Survey of India, Dehradun (BSD) and Forest Research Institute, Dehradun (DD). Identified specimens were properly labeled with detailed botanical name, family, locality, field number, date of collection and other necessary remarks and deposited in the internationally indexed Herbarium of Department of Botany, HNB Garhwal University Srinagar Garhwal (GUH). Valid botanical names along with the author citations of all the recorded plant species were verified from www.theplantlist.org version 1.1 (TPL, 2013).

2.3. Statistical analysis and literature review

For each of the recorded plant species the use value (*UV*), as adapted by Ferreira et al. (2009) from the proposal of Phillips et al. (2002) was calculated. This quantitative method evaluates the relative importance of each medicinal plant species based on its relative use among informants. *UV* was calculated using the following formula:

$$UV = \Sigma \frac{U}{n}$$

where *U* is the number of times a species is cited and *n* is the number of informants. The use value of each species is therefore based objectively on the importance attributed by the informants and does not depend on the opinion of the researcher (Ferreira et al., 2009). Fidelity level (*FL*) was calculated using the following formula:

$$FL(\%) = \frac{Ip}{Iu} \times 100$$

where *Ip* is the number of informants who independently indicated the use of a species for the same major ailment and *Iu* the total number of informants who mentioned the plant for any major ailment (Friedman et al., 1986). To test homogeneity of knowledge about the medicinal plants, the factor informant consensus (F_{ic}) was used (Heinrich et al., 1998; Gazzaneo et al., 2005). The F_{ic} was calculated using the following formula:

$$F_{ic} = \frac{n_{ur} - n_t}{n_{ur} - 1}$$

where n_{ur} is the number of use reports for particular ailment category, and n_t is the number of species used for a particular ailment category by all the informants.

Detailed literature survey was carried out to gather and discuss information about the earlier ethnomedicinal studies recording uses of the listed plants in treatment of any skin disease, other studies showing their antimicrobial, anti-inflammatory, wound healing, toxicological, antioxidant and tryrosinase inhibitory properties and compound or molecules present in these plants which are known antibiotic, antibacterial, antiviral and antifungal agents. Literature was searched from various scientific databases *viz*., Web of Science, CAB international, Google Scholar, Science direct, SciFinder, PubMed, Scopus and DNP CHEMnetBASE.

3. Results and discussion

3.1. Ethnomedicinal plants used by Tharu community

The present exploration has brought in to light the antidermatophytic medicinal plants and herbal medicines used against various skin diseases by Tharu community living in Udham Singh Nagar district of Uttarakhand. A total of 90 plants belonging to 86 genera and 48 families were used by Tharu community to treat 15 categories of skin diseases (Fig. 2). Recently Gairola et al. (2014) have reported list of 321 medicinal plant taxa used to treat dermatological or skin related diseases by various indigenous communities of Jammu & Kashmir. Whereas, Sharma et al. (2013a) have also reported 109 medicinal plants used to treat various skin diseases by Gujjar community of sub-Himalayan tract of Uttarakhand, India. Fifty plant species were used to cure only one skin disease, whereas 40 plant species were used to cure multiple skin diseases. Results of the present investigation are given in Table 1, where information about reported plants species are given along with their botanical names, families, vernacular names, skin disease treated, mode and dose of herbal preparations, *UV* values, distribution, habitat, earlier ethnomedicinal studies in India citing use of plant for treatment of any skin disease and number of times species cited in the reviewed literature to treat any skin disease in India. Frequently used family in skin care by Tharu community was Leguminosae (11 taxa) followed by Lamiaceae (7 taxa), Apocynaceae (6 taxa), Euphorbiaceae (5 taxa), Poaceae (5 taxa), Asteraceae (4 taxa), Anacardiaceae (3 taxa),

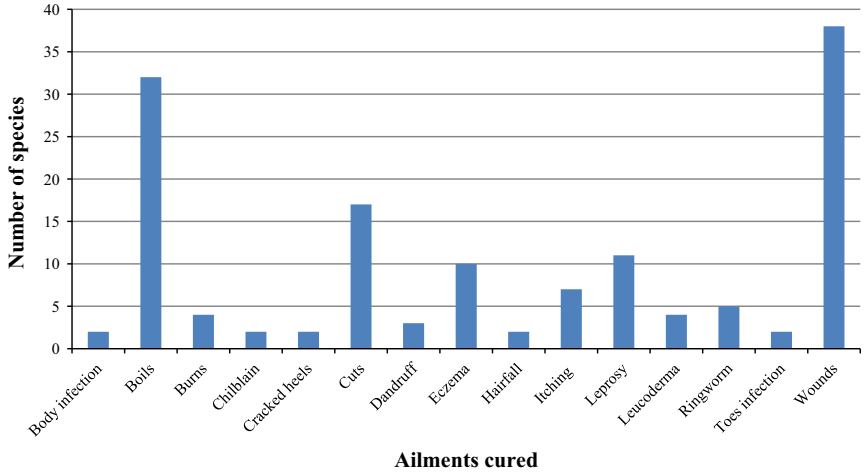

Fig. 2. Number of plant species used to treat different categories of skin diseases.

Table 1
Plants and herbal preparations used as remedy of skin diseases by the Tharu community of district Udham Singh Nagar, Uttarakhand, India.

Plant species (family) voucher specimen number	Vernacular name (Habit)	Mode of preparation and dose	*UV*	Earlier ethnomedicinal studies in India citing use of plant for treatment of any skin disease	Distribution[a]; Habitat (TC)	Uses by Gujjar Community of sub-Himalayan tract (Sharma et al., 2013a)[b]
Acanthaceae						
Dicliptera paniculata (Forssk.) I. Darbysh. [∗*Peristrophe paniculata* (Forssk.) Brummitt] (GUH-JS 20154)	*Harjodi* (H)	The paste of leaves is applied topically on wounds.	0.016	Adhikari et al. (2010), Gaur (1999)	Throughout India, common along waste places, road sides and crop fields to 1400 m asl; W (2)	–
Acoraceae						
Acorus calamus L. (GUH-JS 20355)	*Papri* (H)	The leaf paste is applied topically on wounds. Paste of rhizome is mixed with *Curcuma domestica* rhizome and applied topically on eczema.	0.074	Chopda and Mahajan (2009), Kingston et al. (2009), Pradhan and Badola (2008), Shiddamallayya et al. (2010), Sivaranjani and Ramakrishnan (2012), M. Yadav et al. (2012)	Throughout India in damp marshy places, ascending to 1800 m asl; W & C (6)	–
Amaranthaceae						
Achyranthes aspera L. (GUH-JS 18893)	*Chattisa/ Chircita* (H)	The leaves are crushed and juice is applied topically on boils.	0.336	Bhandary and Chandrashekhar (2002), Bhat et al. (2012), Bhat et al. (2014), Chopda and Mahajan (2009), Gaur and Sharma (2011), Johnsy et al. (2012), Kumar and Vidyasagar (2008), Muthu et al. (2006), Nandagopalan et al. (2011), Patil et al. (2009), Ray et al. (2011), Revathi and Parimelazhagan (2010), Seetharam et al. (1999), J. Sharma et al. (2011), Sharma et al. (2013a), A.K. Sharma et al. (2013), Shiddamallayya et al. (2010), Singh and Maheswari. (1994), Sinha et al. (2013), Sivaranjani and Ramakrishnan (2012), Subramanian et al. (2011), Venkataswamy et al. (2010), Wadankar et al. (2011)	Throughout tropical and subtropical region of India, up to 2100 m asl; W (23)	The paste of leaves is applied externally on skin allergy.
		The leaves are pounded and are applied externally on wounds between toes in rainy season.				
Amaranthus spinosus L. (GUH-JS 18832)	*Katmarsa* (H)	The paste of leaves is mixed with turmeric powder and applied topically on boils. Juice of leaves is applied topically on eczema.	0.311	Adhikari et al. (2010), Choudhary et al. (2011), Sharma et al. (2013a), A.K. Sharma et al. (2013)	Native to tropical America. Common weed in cultivated fields, waste places and along roadsides; W (4)	The paste of roots is applied on boils and carbuncle.
Amaryllidaceae						
Allium cepa L. (GUH-JS 20356)	*Palandu* (H)	The whole plant is crushed and its paste is applied on ringworm.	0.500	Abbasi et al. (2010a), Bhat et al. (2012), Gaur (1999), Sharma et al. (2013a)	Cultivated throughout India, up to 1800 m asl in Himalaya; C (4)	The bulbs are pounded and paste is applied externally on skin allergy.
Anacardiaceae						
Buchanania cochinchinensis (Lour.) M.R. Almeida [∗*Buchanania*	*Chironji* (Tr)	The bark paste is applied topically on cuts and burns. Decoction of bark is taken internally for the same, one teaspoonful, twice a day until the disease cures.	0.090	Gaur (1999), Kala (2009), Kumar and Vidyasagar (2008), Sharma et al. (2013a), Singh et al. (2002)	Drier parts of India; W (5)	Seed powder is mixed with milk and applied on pimples. The paste of leaves is applied over wounds.

lanzan Spreng.] (GUH-JS 20322)						
Lannea coromandelica (Houtt.) Merr. (GUH-JS 18876)	*Jingan* (Tr)	The juice of leaves is applied topically on cuts and wounds.	0.197	Adhikari et al. (2010), Dahare and Jain (2010), Sharma et al. (2013a), Singh et al. (2002), Upadhyay et al. (2010)	Throughout India, ascending to 1500 m asl in the Himalayas; W (5)	The paste of bark is applied externally on wounds.
Semecarpus anacardium L.f. (GUH-JS 20261)	*Bhilwa* (Tr)	The gum is applied topically on leprosy.	0.025	Bhat et al. (2012), Kumar et al. (2012), Pradhan and Badola (2008), Singh et al. (2002), Wadankar et al. (2011)	Sub Himalayan tracts from Himachal Pradesh to Sikkim, Punjab, Assam, Khasi Hills, Madhya Pradesh and Peninsular India; W (5)	–
Annonaceae						
Annona squamosa L. (GUH-JS 20297)	*Sitaphal* (Tr)	The leaves are ground and its paste is applied topically on boils. The powder of seeds is applied on scalp to treat dandruff.	0.131	Bhat et al. (2012), Chopda and Mahajan (2009), Choudhary et al. (2011), Dash and Misra (1999), Gaur (1999), Gaur and Sharma (2011), Nayak et al. (2004), Raja et al. (2009), J. Sharma et al. (2011), A.K. Sharma et al. (2013), Subramanian et al. (2011), Wadankar et al. (2011)	Native to South America and the West Indies, now cultivated throughout India; C (12)	–
Apocynaceae						
Calotropis procera (Aiton) Dryand. (GUH-JS 20351)	*Madar* (S)	The leaves and flowers are crushed together, made into paste and applied topically on boils.	0.279	Choudhary et al. (2011), Gangwar et al. (2010), Kumari and Singh (2009), J. Sharma et al. (2011), Sharma et al. (2013a), Upadhyay et al. (2010)	An evergreen shrub distributed throughout India; W (6)	The roots are ground and applied externally on leucoderma.
Cryptolepis dubia (Burm.f.) M.R. Almeida [∗*Cryptolepis buchananii* Roem. & Schult.] (GUH-JS 19730)	*Dudhi bel* (H)	The latex of the plant is applied topically on wounds, boils or sores	0.066	Adhikari et al. (2010), Bhat et al. (2012), Bhat et al. (2014), Mairh et al. (2010), Subramanian et al. (2011)	Throughout India, ascending to 1200 m asl in Himalaya; W (5)	–
Holarrhena pubescens Wall. ex G.Don (GUH-JS 18830)	*Kurchi* (Tr)	The decoction of seeds is recommended internally to cure leprosy. The paste of leaves is applied topically on boils.	0.279	Bhat et al. (2012), Bhat et al. (2014), Gangwar et al. (2010), Girach et al. (1999), J. Sharma et al. (2011)	Throughout India, tropical Himalayas going up to an altitude of 1100 m asl; W (5)	–
Rauvolfia serpentina (L.) Benth. ex Kurz (GUH-JS 18866)	*Jhaberbarua* (H)	Root paste is topically applied for boils.	0.025	Bhat et al. (2012), Bhat et al. (2014), Gaur et al. (2011), Sharma et al. (2013a)	The sub-Himalayan tract from Punjab to Nepal, Sikkim, Assam, Western Ghats and Andamans; W (4)	The root paste is mixed with oil of *Cinamomum tamala* (tejpaat) and externally applied on leucoderma in night.
Vallaris solanacea (Roth) Kuntze (GUH-JS 19763)	*Bakerghaneli* (S)	The latex is topically applied on wounds.	0.049	Adhikari et al. (2010), Gaur (1999), Sharma et al. (2013a)	Throughout India, Cultivated in gardens; W & C (3)	The plant paste is applied on eczema. **The latex is applied on wounds.**
Wrightia arborea (Dennst.) Mabb. (GUH-JS 20372)	*Dhudli* (Tr)	The latex is applied topically to heal on cuts and wounds.	0.148	Gaur (1999), Reddy et al. (2007), Sharma et al. (2013a)	Sub Himalayan tracts, Punjab, Rajasthan, Bihar, Assam and Western Peninsula; W (3)	**The latex is applied on cuts, wounds** and on skin allergy.
Asteraceae						
Ageratum conyzoides (L.) L.(GUH-JS 18868)	*Gindhoni* (H)	The leaf juice is applied topically on cuts to stop bleeding. The whole plant decoction is taken orally to cure leprosy, 2 ml thrice a day.	0.541	Gaur (1999), Sharma et al. (2010), Sharma et al. (2013a), M. Yadav et al. (2012)	Throughout India, as a weed up to an altitude of 1800 m asl; W (4)	**The leaf juice is applied externally on cuts to stop bleeding**.
Caesulia axillaris Roxb. (GUH-JS 20210)	*Gorghanta* (H)	The paste of flowers is applied topically on cuts and wounds.	0.180	J. Sharma et al. (2011)	Throughout the warmer parts of India, ascending to 1000 m asl; W (1)	–
Eclipta prostrata (L.) L. (GUH-JS 18829)	*Dudhli* (H)	The juice of whole plant is applied topically on cuts, wounds and boils	0.344	Adhikari et al. (2010), Bhat et al. (2014), Chopda and Mahajan (2009), Kamble et al. (2010)	Throughout India, up to 2000 m asl on the hills; W (4)	–
	Mundi (H)		0.623			

Table 1 (*continued*)

Plant species (family) voucher specimen number	Vernacular name (Habit)	Mode of preparation and dose	*UV*	Earlier ethnomedicinal studies in India citing use of plant for treatment of any skin disease	Distribution[a]; Habitat (TC)	Uses by Gujjar Community of sub-Himalayan tract (Sharma et al., 2013a)[b]
Tridax procumbens (L.) L. (GUH-JS 18817)		The paste of leaves is topically applied on cuts and wound to stop bleeding. The juice of leaves is applied on boils.		Gaur (1999), Gaur et al. (2011), Jyothi et al. (2010), Kamble et al. (2010), Kumar and Vidyasagar (2008), Muthu et al. (2006), J. Sharma et al. (2011), Sharma et al. (2013a), Singh et al. (2002), Sinha et al. (2013), Upadhyay et al. (2010)	Waste places, road sides and hedges throughout India; W (11)	**The paste of leaves is applied on cuts and wound to stop bleeding.**
Bignoniaceae						
Oroxylum indicum (L.) Kurz (GUH-JS 20273)	*Phargat* (Tr)	The bark powder is used topically on wounds. Bark paste is applied topically on burns.	0.033	Gaur and Sharma (2011)	Throughout the greater part of India to 1500 m asl; W (1)	–
Boraginaceae						
Ehretia laevis Roxb. (GUH-JS 20101)	*Chamror/ Chamrod* (Tr)	The leaves are ground and its paste is topically applied on wounds	0.041	Gaur and Sharma (2011), Meena and Yadav (2011)	Throughout India, also grown along roadsides; W & C (2)	–
Brassicaceae						
Brassica juncea (L.) Czern. (GUH-JS 20302)	*Lahi* (H)	The paste of seeds is applied topically used on boils.	0.303	Bhat et al. (2012), Sharma et al. (2013a), A.K. Sharma et al. (2013)	Cultivated in Punjab, West Bengal, Uttar Pradesh and Gujarat; C (3)	**The paste of seeds is externally used on boils** and skin allergy.
Cannabaceae						
Cannabis sativa L. (GUH-JS 20224)	*Bhang* (S)	The leaves are fried with mustard oil, made into paste and applied topically on burns.	0.295	Chopda and Mahajan (2009), Negi et al. (2011), Sharma et al. (2004), Sharma et al. (2010)	Cultivated all over the country. Commonly occurs in waste grounds, along road side; W & C (4)	–
Celastraceae						
Celastrus paniculatus Willd. (GUH-JS 19734)	*Kakundan* (S)	The seed paste is applied topically on leprosy.	0.066	Adhikari et al. (2010), Bhat et al. (2014), Chakraborty and Bhattacharjee (2006), Pradhan and Badola (2008), Sharma et al. (2013a)	Sub-Himalayan tract up to 2000 m asl and South Indian hills; W (5)	The paste of leaves is applied externally on eczema. The ash of roots is mixed with fruit piece of *Citrus pseudolimon* (galgal) and placed in an earthen pot for a whole night; the whole material is dried in shade in early morning and made into paste, this preparation is given orally (2-3 gm), twice a day for 10-15 days with cold water to treat body allergy, milk is avoided during treatment.
Cleomaceae						
Cleome viscosa L. (GUH-JS 20170)	*Hulhul* (H)	The whole plant paste is applied topically on wounds. The paste of seeds is applied on scalp during hair fall or to avoid baldness.	0.107	Adhikari et al. (2010), Ayyanar and Ignacimuthu (2009), Ganesan and Kesaven (2003), Gaur (1999), Girach et al. (1999), Kuvar and Bapat (2010), Muthu et al. (2006), Upadhyay et al. (2010)	Throughout India, Tripura, West Bengal and Gangetic valley as a weed; W (8)	–
Combretaceae						
	Kawa (Tr)	The paste of bark is applied topically on leprosy.	0.033			–

Terminalia arjuna (Roxb. ex DC.) Wight & Arn. (GUH-JS 20334)				Kumari and Singh (2009), Muthu et al. (2006), Shiddamallayya et al. (2010)	Throughout the greater part of India, also grown as an avenue tree; W & C (3)	
Commelinaceae						
Commelina benghalensis L. (GUH-JS 20160)	*Kana* (H)	The paste of whole plant is applied topically on wounds	0.025	Adhikari et al. (2010), Ayyanar and Ignacimuthu (2009), Begum and Nath (2000), Gaur (1999), Lal et al. (1996), Sharma et al. (2013a)	Throughout India in moist places; W (6)	**The paste of plant is applied externally on wounds**. The juice of leaves (one teaspoonful) is taken internally twice a day for 1–2 weeks, in the treatment of leprosy.
Convolvulaceae						
Cuscuta reflexa Roxb. (GUH-JS 19749)	*Sarai-babiya* (H)	The paste of whole plant is applied topically to treat eczema. The whole plant paste is applied on scalp to treat dandruff.	0.189	Gaur (1999), Jyothi et al. (2010), Sharma et al. (2013a), Sinha et al. (2013), Upadhyay et al. (2010)	A parasitic climber common throughout India up to 3000 m asl; W (5)	The paste of plant is applied on leprosy.
Ipomoea carnea Jacq. (GUH-JS 20138)	*Beshram* (H)	The leaves are fried in *Brassica campestris* oil (sarsoon) and tied topically on cuts and wounds.	0.377	Adhikari et al. (2010), Sharma et al. (2013a), Singh and Maheswari (1994)	Native to tropical America, widely naturalized in India, common on waste places; W (3)	**The leaves are fried in *Brassica campestris* oil (sarsoon) and tied externally on cuts and wounds to get quick relief**.
Cucurbiatceae						
Momordica dioica Roxb. ex Willd. (GUH-JS 20237)	*Karauna* (H)	The paste of roots is applied topically on boils. Paste of fruit pulp is also used for the same.	0.107	Bhat et al. (2014), Sharma et al. (2013a)	Throughout India, up to 1500 m asl in the Himalaya; C (2)	**The paste of roots is applied on boils**.
Dipterocarpaceae						
Shorea robusta Gaertn. (GUH-JS 20369)	*Kurela* (Tr)	The gum is applied topically on cracks of feet's.	0.041	Gaur and Sharma (2011), Singh et al. (2002)	North, east and central India; W (2)	–
Euphorbiaceae						
Acalypha indica L. (GUH-JS 18853)	*Kuphi* (H)	The paste of leaves is mixed with little quantity of salt and applied topically on eczema. The paste of leaves is mixed with turmeric and topically on affected places to heal wounds.	0.230	Ayyanar and Ignacimuthu (2009), Chopda and Mahajan (2009), Johnsy et al. (2012)	Occurs throughout the plains of India, ascending the hills in Orissa up to 210 m asl; W (3)	–
Euphorbia hirta L. (GUH-JS 18829)	*Dudhli* (H)	The latex of the plant is applied topically on wounds. Latex is also applied on eczema. The paste of whole plant is applied topically on ringworm.	0.156	Ayyanar and Ignacimuthu (2009), Gaur (1999), Gaur et al. (2011), Girach et al. (1999), Jain et al. (2005), Katewa and Galav (2005), Kingston et al. (2009), Kumar et al. (2012), Kumari and Singh (2009), Muthu et al. (2006), Sharma et al. (2013a), A.K. Sharma et al. (2013), Sinha et al. (2013), Sivaranjani and Ramakrishnan (2012), Upadhyaya et al. (1998), M. Yadav et al. (2012)	Throughout warmer regions of India; W (16)	The plant paste is applied externally on cuts and wounds.
Euphorbia thymifolia L. (GUH-JS 20374)	*Dhudiya* (H)	The whole plant paste is used topically for the treatment of itches.	0.033	Shiddamallayya et al. (2010)	Found in tropical plains and low hills of India; W (1)	–
Mallotus philippensis (Lam.) Mull.Arg. (GUH-JS 20148)	*Rohini* (Tr)	The juice of leaves is applied topically on cuts and wounds.	0.066	Gaur et al. (2011), Kamble et al. (2010), Sharma et al. (2010), Sharma et al. (2013a), Singh and Singh (2009), Verma and Chauhan (2007), M. Yadav et al. (2012)	Throughout tropical regions of India; W (7)	The powder of fruits is mixed with ghee, made into paste and externally applied on boils.
Ricinus communis L. (GUH-JS 18877)	*Arandi* (S)	The leaves are fried in oil of mustard, made into paste and topically applied on wounds. The seed paste is applied topically on heel cracks. Seed oil is used to cure eczema.	0.631	Gangwar et al. (2010), Gaur et al. (2011), Johnsy et al. (2012), Kala (2009), Kumar et al. (2012), Kumar and Vidyasagar (2008), Sharma et al. (2013a), Uniyal and Shiva (2005), Upadhyay et al. (2010)	Native of tropical Africa, Found throughout India. Cultivated chiefly in Andhra Pradesh, Maharashtra, Karnataka and Orissa; W & C (9)	**The leaves are fried in oil of mustard, made into paste and externally applied on wounds**.

Table 1 (*continued*)

Plant species (family) voucher specimen number	Vernacular name (Habit)	Mode of preparation and dose	*UV*	Earlier ethnomedicinal studies in India citing use of plant for treatment of any skin disease	Distribution[a]; Habitat (TC)	Uses by Gujjar Community of sub-Himalayan tract (Sharma et al., 2013a)[b]
Hypoxidaceae						
Curculigo orchioides Gaertn. (GUH-JS 18861)	*Musli* (H)	The juice of leaves is squeezed on cuts. Juice of leaves is also used for treating itching.	0.066	Ray et al. (2011), Sharma et al. (2013a), Singh et al. (2002)	Sub-tropical Himalayas from Kumaon eastward, Western Ghats from Konkan Southwards; W (3)	The paste of leaves is applied externally on skin allergy.
Lamiaceae						
Anisomeles indica (L.) Kuntze (GUH-JS 18814)	*Basinga* (S)	The paste of stem is mixed with coconut oil (*Cocos nucifera*) and applied topically on wounds.	0.262	Adhikari et al. (2010), Sharma et al. (2010)	Throughout India, ascending to 1500 m asl in Himalayas; W (2)	–
Callicarpa macrophylla Vahl (GUH-JS 19733)	*Tilkhi/ Dehgala* (S)	The juice of leaves applied topically on chilblains.	0.041	Arya and Agarwal (2008), Sharma et al. (2013a)	Sub-Himalayan tracts, from Hazara eastwards to Assam, up to 1500 m asl; W (2)	**The paste of leaves applied externally on chilbalins**.
Clerodendrum infortunatum L. [∗*Clerodendrum viscosum* Vent.] (GUH-JS 18892)	*Bhatar* (S)	The leaf juice is applied topically on cuts.	0.074	Gaur (1999), Jain et al. (2005), Johnsy et al. (2012), J. Sharma et al. (2011), Vijayan et al. (2007), Bhat et al. (2014), Bhat et al. (2012)	Throughout India; W (7)	–
Hyptis suaveolens (L.) Poit. (GUH-JS 20323)	*Vantulsi* (H)	The paste of leaves is applied topically on cuts and wounds. Juice of leaves is also used for treating itching.	0.098	Kumar and Vidyasagar (2008)	Native to tropical America. Distributed throughout India; W (1)	–
Leonotis nepetifolia (L.) R.Br. (GUH-JS 18887)	*Hijurchi* (H)	The paste of leaves is applied topically on ringworm.	0.066	Dash and Misra (1999), Kumar and Vidyasagar (2008), Kuvar and Bapat (2010), Sharma et al. (2013a), Upadhyaya et al. (1998)	Throughout the warmer parts of India; W (5)	The inflorescence is pounded and its paste is applied on skin allergy.
Premna mollissima Roth [∗*Premna mucronata* Roxb.] (GUH-JS 20368)	*Baka* (S)	The decoction of bark (2 teaspoonfuls) is taken orally twice a day as a remedy for leprosy and its paste is also applied externally for the same. The latex is applied topically on boils.	0.156	Adhikari et al. (2010), Gaur (1999)	Submontane Himalaya in Garhwal to Sikkim, Peninsular India, Bihar, West Bengal and North-eastern India; W (2)	The paste of bark is applied externally on ringworm.
Vitex negundo L. (GUH-JS 18836)	*Nirgndi* (S)	The paste of leaves is used for healing of wounds. The paste of flowers is topically applied on eczema.	0.475	Bhat et al. (2012), Gaur et al. (2011), Ghorband and Biradar (2011), Prakasha and Krishnappa (2006), J. Sharma et al. (2011), Sharma et al. (2013a), Subramanian et al. (2011), Verma and Chauhan (2007)	Throughout India in the warmer zones; ascending to 900 m asl in the North-western Himalaya; W (8)	The leaves are fried in mustard oil, made in to paste and applied on boils.
Lauraceae						
Litsea glutinosa (Lour.) C.B.Rob. (GUH-JS 18823)	*Maida lakri* (Tr)	The bark paste is also applied topically on boil.	0.025	Kumar et al. (2012), Parhar and Biswas (1998), Ramadas et al. (2000), Sharma et al. (2013a)	Throughout the warmer parts of India, sub-montane Himalaya and South India; W (4)	The bark paste is applied on skin allergy.
Leguminosae						
Albizia lebbeck (L.) Benth. (GUH-JS 19740)	*Siris* (Tr)	The juice of crushed leaves is applied topically on boils.	0.262	Chopda and Mahajan (2009), Joshi and Tyagi (2011), Kumari and Singh (2009), Sharma et al. (2010), Shiddamallayya et al. (2010)	All over India, from the plains up to 900 m asl in the Himalayas, also in the Andamans; W (5)	–
Bauhinia variegata L. (GUH-JS 19780	*Kachnar* (Tr)	The root bark decoction is orally taken thrice a day to treat leprosy.	0.057	Negi et al. (2011), Singh et al. (2002), Upadhyay et al. (2010)	Throughout the warmer parts of India up to 1200 m asl, Punjab, Western Peninsula and Assam. Also cultivated in gardens; W & C (3)	–
Butea monosperma (Lam.) Taub. (GUH-JS 18802)	*Palash* (Tr)	The fresh gum is used as antiseptic and applied on cuts and wounds. Juice of flowers is used to cure itching and leprosy.	0.246	Bhat et al. (2014), Gaur (1999), Kala (2009), Katewa et al. (2004), Kumar et al. (2012), Kumari and Singh (2009), Singh et al. (2002)	Throughout India, up to 1200 m asl except in very arid regions; W (7)	–

Cassia fistula L. (GUH-JS 18842)	*Amaltas* (T)	The root paste is applied topically on leprosy. Powder of roots (2-3 gm) is taken internally two or three times a day to cure allergy or itching.	0.279	Bhat et al. (2012), Bhat et al. (2014), Gaur (1999), Johnsy et al. (2012), Jyothi et al. (2010), Kumar et al. (2012), Kumar and Vidyasagar (2008), Kumari and Singh (2009), Mamatha et al. (2006), Rajakumar and Shivanna (2009), Sharma et al. (2013a), A.K. Sharma et al. (2013), Shiddamallayya et al. (2010), Shivanna and Rajakumar (2010), Silja et al. (2008), Sinha et al. (2013), Verma and Chauhan (2007)	Cultivated as an ornamental throughout India; C (17)	Leaf paste is applied externally in ringworm.
Crotalaria juncea L. (GUH-JS 20362)	*Sanai* (S)	The seed paste is mixed with mustard oil and applied topically on wounds	0.033	Gaur and Sharma (2011), Shiddamallayya et al. (2010)	Throughout the warmer parts of India, especially in South India; W (2)	–
Dalbergia sissoo DC. (GUH-JS 20373)	*Siswa* (Tr)	Stem bark is soaked in water for 4–5 hours, made into paste and applied topically on leprosy.	0.148	Johnsy et al. (2012), Joshi and Tyagi (2011), Gaur and Sharma (2011), Sharma et al. (2013a), Gaur (1999)	The sub-Himalayan tract, up to 1200 m asl from Indus to Assam and in plains throughout India; W (5)	Leaves and bark are mixed together, made into paste and applied externally on eczema
Desmodium gangeticum (L.) DC. (GUH-JS 20191)	*Salperni* (H)	The paste of leaves is applied topically on boils.	0.033	Chopda and Mahajan (2009), Jain et al. (2005)	Common on lower hills and plains throughout India, ascending to 1500 m asl on the Himalaya; W (2)	–
Millettia extensa (Benth.) Baker (GUH-JS 20183)	*Bambiri* (S)	The root paste is applied topically on boils or sores.	0.033	Gaur (1999), Kamble et al. (2010), Sharma et al. (2013a)	Himachal Pradesh to Sikkim, Outer submontane Himalaya to 1500 m asl; W (3)	The bark paste is applied over wounds.
Mucuna pruriens (L.) DC. (GUH-JS 20180)	*Gaunj* (S)	The paste of seeds used topically on boils.	0.123	Gaur (1999), Majumdar and Datta (2007), Uniyal and Shiva (2005)	Throughout India, including Andaman and Nicobar Islands; W (3)	–
Pongamia pinnata (L.) Pierre (GUH-JS 18847)	*Papri* (Tr)	The paste of seeds is applied on wounds. The oil of seeds is applied topically to treat eczema.	0.369	Ayyanar and Ignacimuthu (2009), Bhat et al. (2012), Bhat et al. (2014), Ghorband and Biradar (2011), Kingston et al. (2009), Kumar et al. (2012), Muthu et al. (2006), Patil et al. (2009), Sharma et al. (2013a), Shiddamallayya et al. (2010), Silja et al. (2008), Upadhyay et al. (2010)	Native to the Western Ghats, India but found all over India. Also cultivated in parks; W & C (12)	The oil extracted from seeds is externally applied on itching and skin allergy.
Senna tora (L.) Roxb. [≡*Cassia tora* L.] (GUH-JS 20146)	*Kasonji* (H)	Leaves are soaked in water, made into paste and applied topically on boils.	0.336	Adhikari et al. (2010), Gaur (1999), Gaur et al. (2011), Jyothi et al. (2010), Kumar et al. (2012), Sharma et al. (2010), Shiddamallayya et al. (2010), Singh et al. (2002), Sinha et al. (2013), Sivaranjani and Ramakrishnan (2012), Bhat et al. (2014)	Throughout India as a weed; W (11)	The seed powder is mixed with flour of *Triticum aestivum* (wheat), made into paste and applied externally in the treatment of boils.
Linaceae						
Linum usitatissimum L. (GUH-JS 20120)	*Alsi* (H)	The paste of whole plant is applied topically on wounds.	0.025	Adhikari et al. (2010), Sharma et al. (2013a)	Cultivated throughout India; C (2)	The paste of seeds is applied externally on boils.
Loranthaceae						
Dendrophthoe falcata (L.f.) Ettingsh. (GUH-JS 20294)	*Banda* (H)	The juice of bark is applied topically on wounds.	0.025	Ayyanar and Ignacimuthu (2009), Mairh et al. (2010), Sharma et al. (2013a), Singh et al. (2002)	Throughout India; W (4)	The roots are crushed and its juice is applied on skin allergy.
Lythraceae						
Lawsonia inermis L. (GUH-JS 18843)	*Mehndi* (S)	The leaf paste is applied on cracked heels in rainy season due to mud infection	0.311	Gaur (1999), Jain et al. (2005), Kingston et al. (2009), Kumar and Vidyasagar (2008), Kumar et al. (2012), Muthu et al. (2006), A.K. Sharma et al. (2013), Silja et al. (2008), M. Yadav et al. (2012)	Native to Arabia and Persia; Cultivated in northern and central India; C (9)	–

Table 1 (*continued*)

Plant species (family) voucher specimen number	Vernacular name (Habit)	Mode of preparation and dose	*UV*	Earlier ethnomedicinal studies in India citing use of plant for treatment of any skin disease	Distribution[a]; Habitat (TC)	Uses by Gujjar Community of sub-Himalayan tract (Sharma et al., 2013a)[b]
Malvaceae						
Sida cordata (Burm. F.) Borss. Waalk. (GUH-JS 19753)	*Bareyara* (H)	The paste of leaves is topically applied on boils.	0.238	Adhikari et al. (2010), Katewa et al. (2004), Kumar and Sankar (2003), Purkayastha et al. (2005), Reddy et al. (2010), Senthilkumar et al. (2006a), J. Sharma et al. (2011)	Throughout hotter parts of India; W (7)	–
Sida rhombifolia L. (GUH-JS 20320)	*Bariyara* (H)	The root paste is topically applied on boils or abscess. The leaves are crushed and applied on wounds.	0.352	Adhikari et al. (2010), Gaur (1999), Singh and Maheswari (1994)	Throughout India, in moist places; W (3)	–
Martyniaceae						
Martynia annua L. (GUH-JS 20105)	*Bicchua* (S)	The oil of seeds is used topically in treatment of eczema.	0.303	Chakraborty and Bhattacharjee (2006), Adhikari et al. (2010), Jain et al. (2005)	Native of Mexico, found throughout India; W (3)	–
Meliaceae						
Azadirachta indica A. Juss. (GUH-JS 18826)	*Nimba* (Tr)	The stem bark is burnt and ash is applied topically on boils. Decoction of leaves is used to bath for the treatment of body infection. Its decoction is also taken orally for the treatment of the same. The seed oil is used externally to kill lice and to treat dandruff.	0.615	Bhat et al. (2012), Bhat et al. (2014), Choudhary et al. (2011), Dahare et al. (2010), Gaur (1999), Hiremath et al. (2010), Johnsy et al. (2012), Jyothi et al. (2010), Kingston et al. (2009), Kumar and Vidyasagar (2008), Kumar et al. (2012), A.K. Sharma et al. (2013), Shiddamallayya et al. (2010), Singh and Maheswari (1994), Singh et al. (2002), Sinha et al. (2013), Subramanian et al. (2011), Upadhyay et al. (2010), M. Yadav et al. (2012)	Native to Burma, found all over India; W (19)	–
Menispermaceae						
Cissampelos pareira L. (GUH-JS 18827)	*Madrachi* (H)	The juice of leaves is applied topically to cure itching. The roots are crushed made into paste and applied topically on leucoderma. The infusion of leaves (2 ml) is also taken internally, twice a day to heal wounds.	0.115	Ayyanar and Ignacimuthu (2009), Kuvar and Bapat (2010), Pradhan and Badola (2008), Sharma et al. (2013a)	The tropical and sub-tropical parts of India; W (4)	The paste of leaves is externally applied on boils.
Moraceae						
Ficus benghalensis L. (GUH-JS 18878)	*Bargad* (Tr)	The latex is applied topically on boils. The paste of leaves is mixed with coconut oil and applied topically on burns.	0.262	Ayyanar and Ignacimuthu (2009), Gaur and Sharma (2011), Johnsy et al. (2012), Katewa et al. (2004), J. Sharma et al. (2011)	Sub-Himalayan tract and Peninsular India. Planted along roadsides, and in gardens; W & C (5)	–
Ficus racemosa L. (GUH-JS 20127)	*Gillor* (Tr)	The latex is applied topically on boils	0.172	Ayyanar and Ignacimuthu (2009), Bhat et al. (2012), Negi et al. (2002), Punjani (2002), Sen and Behara (2003), Sharma et al. (2013a), Shiddamallayya et al. (2010), Shiddamallayya et al. (2010), Silja et al. (2008), Upadhyay et al. (2010)	Throughout India. Grows wild in forests and hills; W (10)	The paste of leaves is used in healing of wounds. The decoction (1–2 teaspoonfuls) of fruits is taken internally once a day for 2 weeks, to cure leprosy and its paste is applied externally for the same.
Ficus religiosa L. (GUH-JS 20366)	*Peepal* (Tr)	Bark paste is applied topically on boils	0.246	Ayyanar and Ignacimuthu (2009), Gaur (1999), Johnsy et al. (2012), Bhat et al. (2014)	Sub-Himalayan tracts, West Bengal, Central and South India; planted throughout India as an avenue tree; W & C (4)	–
Nyctaginaceae						
Boerhavia diffusa L. (GUH-JS 18845)	*Punarnava* (H)	The whole plant is pounded and its paste is applied topically on boils.	0.213	Chopda and Mahajan (2009)	Throughout India as a weed; W (1)	–

Mirabilis jalapa L. (GUH-JS 20343)	*Gulbans* (H)	The leaf juice is applied topically on boils or abscess.	0.057	Bhat et al. (2012), Hiremath et al. (2010), Kamble et al. (2010), Sharma et al. (2013a), Tomar (2009)	North-West Himalayas, Bengal and Manipur; W (5)	**The leaf juice is applied externally on boils**.
Orchidaceae						
Vanda tessellata (Roxb.) Hook. ex G.Don. (GUH-JS 20349)	*Harjori* (H)	Root paste is applied topically on boils or carbuncle.	0.016	J. Sharma et al. (2011), Sharma et al. (2013a)	Sub-Himalayan tracts to 1500 m asl, Assam; W (2)	**The root paste is applied externally on boils**.
Papaveraceae						
Argemone mexicana L. (GUH-JS 18838)	*Pili kantiya* (H)	The paste of seeds is applied topically on itching. The seed oil is applied topically to treat ringworm. The yellow latex of the leaves is applied topically to cure chilblains. The yellow latex is applied between toes while working on paddy fields.	0.336	Chopda and Mahajan (2009), Choudhary et al. (2011), Dahare et al. (2010), Johnsy et al. (2012), Kingston et al. (2009), Kumar and Vidyasagar (2008), Kumar et al. (2012), Kumari and Singh (2009), Reddy et al. (2010), Sharma et al. (2013a), Sivaranjani and Ramakrishnan (2012)	Native to America, naturalized throughout India; W (11)	The latex is applied externally in cracks on feet. The latex along with cow milk is placed in copper pot for 3 days and applied externally in leucoderma. **The yellow latex is applied between toes while working on paddy fields**.
Pedaliaceae						
Sesamum indicum L. [∗*Sesamum orientale* L.] (GUH-JS 20143)	*Til* (H)	The oil of seeds is applied topically in leprosy. The paste is applied on boils.	0.090	A.K. Sharma et al. (2013)	Up to 1500 m asl in Himalaya and in Uttar Pradesh, Madhya Pradesh, Rajasthan, Orissa, Gujarat, Andhra Pradesh, Tamil Nadu and Maharashtra; W & C (1)	–
Phyllanthaceae						
Phyllanthus amarus Schumach. and Thonn. (GUH-JS 19748)	*Jarmala* (H)	The juice of roots is applied topically on cuts and wounds.	0.172	Gaur (1999), Sharma et al. (2013a), Silja et al. (2008), Upadhyay et al. (2010)	Throughout the hotter parts of India, particularly in cultivated land, up to 1000 m asl; W (4)	The crushed leaves are made into paste and applied externally on skin allergy.
Plantaginaceae						
Scoparia dulcis L. (GUH-JS 20229)	*Bichu* (H)	Paste of leaves is topically applied on wounds.	0.098	Ayyanar and Ignacimuthu (2009)	Native to tropical America. Introduced in India, commonly found in many parts of India; W (1)	–
Poaceae						
Bambusa bambos (L.) Voss [∗*Bambusa arundinacea* Willd.] (GUH-JS 20358)	*Bans* (S)	The paste of stem is applied topically on wounds.	0.033	Chopda and Mahajan (2009), Johnsy et al. (2012)	Wild throughout India, especially in the hill forests; W (2)	–
Chrysopogon zizanioides (L.) Roberty [∗*Vetiveria zizanioides* (L.) Nash] (GUH-JS 19729)	*Seenk* (S)	The paste of roots is topically applied on boils.	0.295	Gaur (1999), J. Sharma et al. (2011)	A perennial grass cultivated almost throughout India; C (2)	–
Cynodon dactylon (L.) Pers. (GUH-JS 20293)	*Dhoob* (H)	The whole plant paste is applied topically on cuts and wounds to stop bleeding	0.328	Abbasi et al. (2010), Bhandary and Chandrashekhar (2002), Bhat et al. (2012), Bhat et al. (2014), Chopda and Mahajan (2009), Gangwar et al. (2010), Kingston et al. (2009),	Throughout India up to 3000 m asl; W (14)	**The plant paste is applied on cuts and wounds to stop bleeding**.

Table 1 (*continued*)

Plant species (family) voucher specimen number	Vernacular name (Habit)	Mode of preparation and dose	*UV*	Earlier ethnomedicinal studies in India citing use of plant for treatment of any skin disease	Distribution[a]; Habitat (TC)	Uses by Gujjar Community of sub-Himalayan tract (Sharma et al., 2013a)[b]
				Negi et al. (2011), Pradhan and Badola (2008), Sharma et al. (2013a), Shiddamallayya et al. (2010), Sivaranjani and Ramakrishnan (2012), Subramanian et al. (2011), Upadhyay et al. (2010)		
Desmostachya bipinnata (L.) Stapf (GUH-JS 20303)	*Dubh* (S)	The roots are dried and its powder is sprinkled on wounds.	0.033	Upadhyay et al. (2010)	Throughout the plains of India in dry and hot areas and in sandy deserts; W (1)	–
Eulaliopsis binata (Retz.) C.E.Hubb. (GUH-JS 18808)	*Baib* (H)	The juice of leaves is applied topically on cuts and wounds.	0.115	Sharma et al. (2013a)	Northern India; W (1)	**The plant juice is applied on cuts.**
Polygonaceae						
Persicaria barbata (L.) H.Hara (GUH-JS 18806)	*Bhidiya* (H)	The paste of leaves is applied topically on boils. Juice or paste of leaves is applied on wounds to cure pain.	0.115	Gaur and Sharma (2011), Sharma et al. (2013a)	Throughout the warmer parts o India, ascending to 1400 m asl; W (2)	The juice of leaves is applied on cuts.
Ranunculaceae						
Ranunculus sceleratus L. (GUH-JS 18810)	*Jaldhaniya* (H)	The paste of leaves is applied topically on boils.	0.205	Gaur (1999), Rani et al. (2013)	The plains of northern India, and the warm valleys of the Himalayas from Kashmir to Assam; W (2)	–
Rhamnaceae						
Ziziphus nummularia (Burm. f.) Wight & Arn. (GUH-JS 20328)	*Jharberiya* (S)	The bark paste is applied on eczema. The seeds are burnt, ash is mixed with a little amount of honey and applied to avoid baldness (hair fall).	0.123	Katewa et al. (2004), Mairh et al. (2010), Singh et al. (2002)	Throughout warmer parts of India in wastelands; W (3)	–
Rubiaceae						
Mitragyna parvifolia (Roxb.) Korth. (GUH-JS 19793)	*Kaim* (Tr)	The paste of leaves is applied topically on cuts and wounds. The bark paste is applied topically on leucoderma.	0.107	Nil	All over India, up to 1200 m asl in the outer Himalaya; W (0)	–
Scrophulariaceae						
Verbascum thapsus L. (GUH-JS 18811)	*Chudighass* (H)	The paste of leaves is mixed with sarsoon oil and topically applied on boils.	0.139	Lal and Singh (2008), Sharma et al. (2013a)	Temperate Himalayas, Western Ghats and the Nilgiris; up to 2500; W (2)	The seed paste is used externally on leucoderma.
Solanaceae						
Solanum incanum L. (GUH-JS 20329)	*Kachriya* (S)	The roots are pounded and applied topically on leucoderma.	0.049	Gaur (1999)	Sub Himalayan tracts and South India; W (1)	–
Datura stramonium L. (GUH-JS 20364)	*Kala daturu* (H)	The leaves are grounded with little quantity of black pepper powder and applied topically on wounds.	0.287	Kumar and Vidyasagar (2008), Kumari and Singh (2009), Sivaranjani and Ramakrishnan (2012)	From Kashmir to Sikkim hilly districts of Central and South India, up to 2700 m asl; W (3)	–
Nicotiana plumbaginifolia Viv. (GUH-JS 19713)	*Bhangraleeg* (H)	The paste of roots is applied topically on leucoderma. The leaf paste is applied topically on wounds. Juice of leaves is applied on itches.	0.148	Dangwal et al. (2010), Sharma et al. (2013a)	Native of Mexico and West Indies, widely distributed in India, common along road sides; W (2)	**The leaf paste is applied externally on wounds and itching.**

Typhaceae						
Typha domingensis Pers. [∗*Typha angustata* Bory & Chaub.] (GUH-JS 20308)	*Pater* (S)	The fruit paste is topically applied on wounds.	0.008	Katewa et al. (2004)	Throughout India, up to 1730 m asl; W (1)	–
Ulmaceae						
Holoptelea integrifolia Planch. (GUH-JS 20219)	*Chilbil* (Tr)	The paste of stem bark is applied topically on ringworm.	0.074	Gaur and Sharma (2011), Meena and Yadav (2011), Sharma et al. (2013a), Upadhyay et al. (2010)	Throughout greater parts of India, also grown in gardens; W & C (4)	The tender leaves paste is applied externally on eczema. The paste of inner bark is applied on blisters.
Verbenaceae						
Lantana camara L. (GUH-JS 20223)	*Lalten* (S)	Leaf juice is applied topically on cuts and wounds.	0.352	Bhat et al. (2012), Gaur (1999), Jyothi et al. (2010), Kumar and Vidyasagar (2008), Mamatha et al. (2006), Pradhan and Badola (2008), Rajakumar and Shivanna (2009), Sharma et al. (2013a), Sinha et al. (2013), Subramanian et al. (2011), Upadhyay et al. (2010), Wadankar et al. (2011)	Native to tropical America. Naturalized and occurs throughout India; W (12)	The paste of leaves is applied on ringworm.

Abbreviations: *C*=cultivated; *FL*=fidelity level; *H*=herb; *S*=shrub; *TC*=number of times species cited in the reviewed literature to treat any skin disease in India; Tr=Tree; *UV*=use value; W & C=both wild as well as cultivated; W=Wild.

[a] Sources (Gaur, 1999; Khare, 2007).

[b] Uses in bold denotes exactly same use of same plant part as recorded in the present study.

Moraceae (3 taxa), Solanaceae (3 taxa), Amaranthaceae (2 taxa), Convolvulaceae (2 taxa), Malvaceae (2 taxa) and Nyctaginaceae (2 taxa). In some earlier studies it was estimated that approximately one third of all the traditional medicines are for treatment of wounds or skin disorders, compared to only 1–3% of modern drugs (Mantle et al., 2001). Literature review revealed that in most of the earlier studies very few plants have been reported for treatment of hair fall, dandruff and toes infection, whereas large numbers of plants have been reported for treatment of wounds, cuts and boils. In the present study maximum number of plants (38 spp.) were used to treat wounds followed by boils (32 spp.), cuts (18 spp.), leprosy (11 spp.), eczema (10 spp.), itching (7 spp.), ringworm (5 spp.), burns (4 spp.), leucoderma (4 spp.), cracked heels (2 spp.), dandruff (3 spp.), body infection (2 spp.), chilblains (2 spp.), hair fall (2 spp.) and toes infection (2 spp.) (Fig. 2).

As shown in Fig. 3, among different plant parts, leaves (48.28%) were the most commonly used for preparation of herbal ointment followed by seeds (17.24%), roots (14.94%), whole plant (13.79%), stem (5.75%), flower (4.60%) and fruit (2.30%). It has been noticed that leaves were frequently used as a remedy to cure skin ailments as compared to any other plant part due to their easy availability in case of cuts and wounds to stop bleeding and fast relief. Latices of 8 plant species were directly applied topically on the affected body part *viz*., latices of *Cryptolepis dubia* (Burm.f.) M.R.Almeida, *Ficus benghalensis* L., *Ficus racemosa* L. and *Premna mollissima* Roth for boils; latices of *Cryptolepis dubia* (Burm.f.) M.R.Almeida, *Euphorbia hirta* L., *Vallaris solanacea* (Roth) Kuntze and *Wrightia arborea* (Dennst.) Mabb. for wounds; yellow latex of *Argemone mexicana* L. for chilblains; latex of *Cryptolepis dubia* (Burm.f.) M.R.Almeida for sores; latex of *Euphorbia hirta* L. for eczema; latex of *Wrightia arborea* (Dennst.) Mabb. for cuts. Similarly, gums of three plant species were also used topically on the skin i.e, fresh gum of *Butea monosperma* (Lam.) Taub. as antiseptic on cuts and wounds; gum of *Semecarpus anacardium* L.f. to cure leprosy; and gum of *Shorea robusta* Gaertn. on cracked heels.

As shown in Fig. 4, most frequently used form of external administration of herbal medicine was paste (65.05%), which is prepared by pulverizing plant matter with water. Externally, a squeezed juice of the plant part was directly used in 18.45% of preparations, followed by use of latex (8.74%), seed oil (5.83%), powder (3.88%), gum (2.91%) and ash (1.94%). In most of the cases herbal combinations were applied topically on affected parts to heal skin disorders but internally decoction (6 preparations) was most commonly used mode of administration followed by infusion and powder form. Seeds were usually applied in the form of paste over the skin, but in some cases seed oil was used *viz*. seed oil of *Argemone mexicana* L., *Martynia annua* L., *Pongamia pinnata* (L.) Pierre, *Ricinus communis* L. and *Sesamum indicum* L. Addition of oil of other plant species *i.e*., mustard (*Brassica rapa* L.) and coconut (*Cocos nucifera* L.) with the recorded plants in some medicinal formulations was also recorded. The oil of mustard seeds was mixed with seed paste of *Crotalaria juncea* L. and applied on the wound. In some cases leaves of *Cannabis sativa* L., *Ricinus communis* L. and *Ipomoea carnea* Jacq. were separately fried in mustard oil, made into paste and applied on affected body part. Leaf pastes of *Anisomeles indica* (L.) Kuntze and *Ficus benghalensis* L. were mixed with coconut (*Cocos nucifera* L.) oil and used topically for healing. Besides that black pepper (*Piper nigrum* L.) and common salt (NaCl or Sodium Chloride) in minute quantities were also added in some formulations, for example the leaf paste of *Acalypha indica* L. was mixed with a little quantity of salt and applied topically on eczema. The possible reason for use of common salt is that it enters the tissue and in effect binds the water, inhibiting the activity of bacteria and fungi, which could in turn help in rapid healing of the skin. Similarly, very little quantity of black pepper powder was grounded with leaves of *Datura stramonium* L. and applied on wounds. This seems to be very scientific as Piperine a major active component of black and long peppers, has been reported to enhance drug bioavailability by inhibiting certain enzyme metabolism (Atal et al., 1985). Addition of salt and black pepper was believed to have synergistic effect in the treatment of skin ailment.

Available ethnomedicinal literature was reviewed to study whether plants reported in the present study are used by any other indigenous community in India to treat any skin ailment (Table 1). *Mitragyna parvifolia* (Roxb.) Korth. was not reported in any of the earlier studies to treat any skin disease. Some little known ethnomedicinal plant species used to treat skin diseases reported in the present study, which were cited in only one study were *Boerhavia diffusa* L., *Caesulia axillaris* Roxb., *Desmostachya bipinnata* (L.) Stapf, *Eulaliopsis binata* (Retz.) C.E.Hubb., *Euphorbia thymifolia* L., *Hyptis suaveolens* (L.) Poit., *Oroxylum indicum* (L.) Kurz, *Scoparia dulcis* L., *Sesamum indicum* L., *Solanum incanum* L. and *Typha domingensis* Pers. (Table 1). According to literature survey the most commonly used plant species to treat skin diseases in India is *Achyranthes aspera* L. (23), followed by *Azadirachta indica* A. Juss. (19 citations), *Cassia fistula* L. (17 citations), *Euphorbia hirta* L. (16 citations), *Cynodon dactylon* (L.) Pers. (14 citations), *Annona squamosa* L. (12 citations), *Pongamia pinnata* (L.) Pierre (12 citations), *Lantana camara* L. (12 citations), *Tridax procumbens* (L.) L. (11 citations), *Senna tora* (L.) Roxb. (11 citations), *Argemone mexicana* L. (10 citations), *Ficus racemosa* L. (10 citations), *Ricinus communis* L. (9 citations) and *Lawsonia inermis* L. (9 citations).

Out of the recorded 90 plant species, 8 plant species are cultivated (*Allium cepa* L., *Annona squamosa* L., *Brassica juncea* (L.) Czern., *Cassia fistula* L., *Chrysopogon zizanioides* (L.) Roberty, *Lawsonia inermis* L., *Linum usitatissimum* L. and *Momordica dioica* Roxb. ex Willd.), whereas 12 plant species (*Acorus calamus* L., *Bauhinia variegata* L., *Cannabis sativa* L., *Ehretia laevis* Roxb., *Ficus benghalensis* L., *Ficus religiosa* L., *Holoptelea integrifolia* Planch., *Pongamia pinnata* (L.) Pierre, *Ricinus communis* L., *Sesamum indicum* L., *Terminalia arjuna* (Roxb. ex DC.) Wight & Arn. and *Vallaris solanacea* (Roth) Kuntze.) are used from both wild as well as cultivated sources. Remaining 70 plant species are available in wild.

All the reported plant species are widely distributed through out India (Table 1). Twelve plant species are non-native or introduced to India, but they are now naturalized throughout the country including the study area. These plant species are *Amaranthus spinosus* L., *Annona squamosa* L., *Argemone mexicana* L., *Azadirachta indica* A. Juss., *Hyptis suaveolens* (L.) Poit., *Ipomoea carnea* Jacq., *Lantana camara* L., *Lawsonia inermis* L., *Martynia annua* L., *Nicotiana plumbaginifolia* Viv., *Ricinus communis* L. and *Scoparia dulcis* L. According to *UV* value most preferred plant species to treat skin diseases by Tharu community is *Ricinus communis* L. (0.631) followed by *Tridax procumbens* (L.) L. (0.623), *Azadirachta indica* A. Juss. (0.615), *Ageratum conyzoides* (L.) L. (0.541) and *Allium cepa* L. (0.500). The F_{ic} values for different categories of skin diseases and *FL* of all the reported plant species are given in Table 2. Values of F_{ic} ranged from 0.880 for leucoderma to 0.976 for cracked heels. High F_{ic} values in the present study suggest that there is ample exchange of information between informants and there is well defined selection criterion in the community for use of these plants (Gazzaneo et al., 2005).

The usage pattern of medicinal plant resources by any particular community is usually unique to that particular community and is part of its cultural traditional knowledge, which is passed on from one generation to another. Most of the studies on medicinal plants focus on the role of these plants within one culture or one ethnic group and little emphasis have been given to the comparison of medicinal plant species in various cultures (Heinrich et al., 1998). In past few decades some researchers have drawn attention of research community to the lack of information on the relative

importance of a medicinal plant within a culture and the need for comparing the use of plants interculturally (Heinrich et al., 1992, 1998; Aguilar et al., 1994; Etkin, 1994; Moreman, 1996). Earlier some workers have studied intercultural importance of medicinal plants between various cultures in different parts of the world (Heinrich et al., 1998; Leonti et al., 2006, 2009, 2010; Lardos and Heinrich, 2013; Gairola et al., 2014). This intercultural comparison approach is practical since both consensus and variations can be addressed by this approach (Heinrich et al., 1998). Therefore to see how widespread presently recorded plants are used to treat skin diseases in the sub-Himalayan region of Uttarakhand, we compared results of the present study with results of one of our earlier published study on Gujjar community inhabiting forests with similar vegetation in nearby districts of Dehradun, Haridwar and Pauri in sub-Himalayan region of Uttarakhand (Sharma et al., 2013a). In that study we had recorded 109 medicinal plants used to treat skin diseases by Gujjar community (for details see Sharma et al. (2013a)). Gujjar community is one of the important migratory communities of the Himalaya. When we compared results of these two studies we observed that although both the communities inhabit forests with similar vegetation but medicinal plant usage pattern of both the communities is very much different from each other and unique to them. A total of 154 plant species were used by both the communities combined to treat skin diseases out of which use of 46 plant species was common between these communities. But out of these 46 plant species only 16 plant species were used in exactly same way to treat same type of skin disease (Table 1 and Fig. 5). Although rest 30 plant species were also used by both the communities, but plant part used, skin disease treated and methods of preparation were different. For comparison, information about uses of these 46 plants by Gujjar community is given in Table 1. Since these communities inhabit nearby forest regions from hundreds of years, some exchange of information regarding usage of medicinal plants between these communities is inevitable, which could be one of the possible reasons for consensus on these 16 plants with exactly same usage.

Availability of herbal resources is sometimes suggested as one of the main criterion for selection of plants by the communities (Moreman, 1996; Heinrich et al., 1998). But in the present case both the communities inhabit forests with similar vegetation and availability of herbal resources are almost identical to them. Therefore, it seems that selection of medicinal plants by these communities is not random or based solely on the availability of the resources and there are some specific criteria, which are used by each community for selecting these plants. These criterions could well be related to cultural, social and religious backgrounds of these communities and are responsible for variation in medicinal plant usage pattern. However, in future studies it would be interesting to assess differences in specific criterions used by these communities to select medicinal plants, and exchange of knowledge on uses of medicinal plants between these and other communities inhabiting sub-Himalayan region of Uttarakhand.

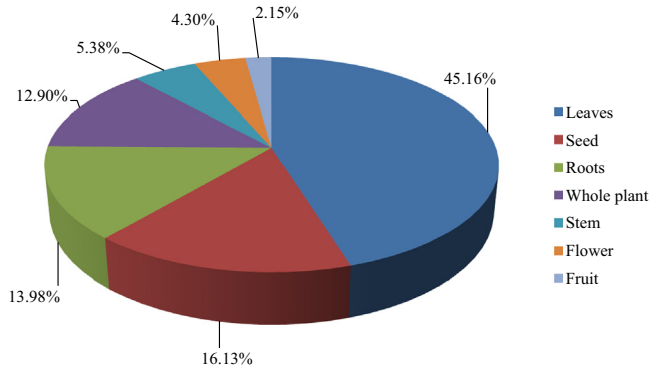

Fig. 3. Percentage of plant parts used in herbal preparations as remedy of skin diseases.

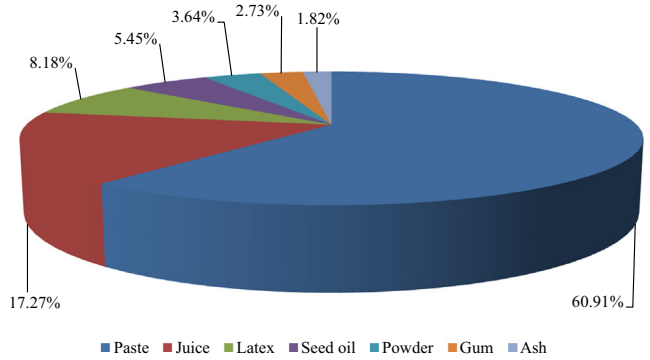

Fig. 4. Percentage of different modes of preparation of herbal remedies used to treat skin diseases.

3.2. Pharmacological, toxicological and clinical considerations

Some categories of skin diseases are caused by bacteria and fungi, while others are caused by environmental conditions. For example, boils are caused by bacteria or fungi present on the skin surface, leprosy is a chronic infection caused by *Mycobacterium leprae* and *Mycobacterium lepromatosis,* eczema is a bacterial infection caused by the bacteria *Staphylococcus aureus*, ringworm is a fungal infection caused by dermatophytes of genera *Trichophyton* and *Microsporum*. Whereas, leucoderma, also known as vitiligo is a condition in which loss of skin pigments take place. Causes of vitiligo are unknown but according to some studies it is autoimmune condition in which immune system of body destroy its own cells and tissues. Wounds and cuts are of external physical origin, chilblains are tissue injury develop as an abnormal response to cold, Itching also known as pruritus is an irritating sensation on skin, which may be caused by allergy and variety of micro-organisms. Tharu community use medicinal plants to treat almost all the category of skin diseases. Details of earlier studies showing wound healing, toxicological, antioxidant and tyrosinase inhibitory properties of the plants recorded in the present study have been provided in Table 3. Whereas, summary of the earlier studies showing antiinflammatory and antimicrobial activities, and active compounds in the plants reported in the present study have been given in Table 4. Toxicological, pharmacological, clinical and other information on the recorded plants related to the skin diseases have been discussed below.

Acalypha indica L. has shown wound healing, antiinflammatory, antioxidant and antimicrobial properties in earlier the studies (Tables 3 and 4). Its ethanol extract showed significant antioxidant activity in superoxide and hydroxyl radical scavenging activity and effect on lipid peroxidation tests (Joy and Mathew, 2010), whereas aqueous extract showed DPPH radical scavenging activity with IC_{50} value of 527.86 μg/ml (Guha et al., 2011). In toxicity test ethanolic extract of whole plant has been found to be non-toxic to male Wistar albino rats even at dose of 2000 mg/kg bw (Sathya et al., 2012). In the present study it is reported to be used topically on wounds, which corroborates with the aforesaid scientific studies done on this plant. However human clinical trial related to any skin disease has not been conducted on this plant.

Achyranthes aspera L. has shown wound healing, antiinflammatory, antioxidant and antimicrobial properties in the earlier studies (Tables 3 and 4). The methanol extract, alkaloid, non-alkaloid and saponin fractions of *Achyranthes aspera* L. leaves exhibited

Table 2
Consensus factor values for different illness categories and Fidelity level of the plant species used to treat various skin diseases by Tharu community.

Illness categories (F_{ic})	Plant species (*FL*)
Body infection (0.933)	*Acalypha indica* (14.29), *Azadirachta indica* (16.00)
Boils (0.944)	*Achyranthes aspera* (48.78), *Albizia lebbeck* (100.00), *Amaranthus spinosus* (63.16), *Annona squamosa* (31.25), *Azadirachta indica* (41.33), *Boerhavia diffusa* (100.00), *Brassica juncea* (100.00), *Calotropis procera* (100.00), *Chrysopogon zizanioides* (100.00), *Cryptolepis dubia* (37.50), *Desmodium gangeticum* (100.00), *Eclipta prostrata* (21.43), *Ficus benghalensis* (40.63), *Ficus racemosa* (100.00), *Ficus religiosa* (100.00), *Holarrhena pubescens* (20.59), *Litsea glutinosa* (100.00), *Millettia extensa* (100.00), *Mirabilis jalapa* (100.00), *Momordica dioica* (100.00), *Mucuna pruriens* (100.00), *Persicaria barbata* (28.57), *Premna mollissima* (42.11), *Ranunculas sceleratus* (100.00), *Rauvolfia serpentina* (100.00), *Senna tora* (100.00), *Sesamum indicum* (45.45), *Sida cordata* (100.00), *Sida rhombifolia* (32.56), *Tridax procumbens* (36.84), *Vanda tesselata* (100.00), *Verbascum thapsus* (100.00)
Burn (0.953)	*Buchanania cochinchinensis* (63.64), *Cannabis sativa* (100.00), *Ficus benghalensis* (59.38), *Oroxylum indicum* (75.00)
Chilblain (0.900)	*Argemone mexicana* (14.63), *Callicarpa macrophylla* (100.00)
Cracked heels (0.976)	*Lawsonia inermis* (100.00), *Shorea robusta* (100.00)
Cuts (0.949)	*Ageratum conyzoides* (84.85), *Buchanania cochinchinensis* (36.36), *Butea monosperma* (46.67), *Caesulia axillaris* (77.27), *Clerodendrum infortunatum* (100.00), *Curculigo orchioides* (50.00), *Cynodon dactylon* (65.00), *Eclipta prostrata* (47.62), *Eulaliopsis binata* (78.57), *Hyptis suaveolens* (66.67), *Ipomoea carnea* (73.91), *Lannea coromandelica* (79.17), *Lantana camara* (60.47), *Mallotus philippensis* (50.00), *Mitragyna parvifolia* (23.08), *Phyllanthus amarus* (71.43), *Tridax procumbens* (63.16), *Wrightia arborea* (77.78)
Dandruff (0.966)	*Annona squamosa* (68.75), *Azadirachta indica* (42.67), *Cuscuta reflexa* (69.57)
Eczema (0.959)	*Acalypha indica* (64.29), *Acorus calamus* (55.56), *Amaranthus spinosus* (36.84), *Cuscuta reflexa* (30.43), *Euphorbia hirta* (26.32), *Martynia annua* (100.00), *Pongamia pinnata* (100.00), *Ricinus communis* (62.34), *Vitex negundo* (60.34), *Ziziphus nummularia* (46.67)
Hair fall (0.933)	*Cleome viscosa* (61.54), *Ziziphus nummularia* (53.33)
Itching (0.885)	*Argemone mexicana* (24.39), *Cassia fistula* (58.82), *Cissampelos pareira* (50.00), *Curculigo orchioides* (50.00), *Euphorbia thymifolia* (100.00), *Hyptis suaveolens* (16.67), *Nicotiana plumbaginifolia* (33.33)
Leprosy (0.916)	*Ageratum conyzoides* (15.15), *Bauhinia variegata* (100.00), *Butea monosperma* (40.00), *Cassia fistula* (41.18), *Celastrus paniculatus* (100.00), *Dalbergia sissoo* (100.00), *Holarrhena pubescens* (79.41), *Premna mollissima* (57.89), *Semecarpus anacardium* (100.00), *Sesamum indicum* (54.55), *Terminalia arjuna* (100.00)
Leucoderma (0.880)	*Cissampelos pareira* (35.71), *Mitragyna parvifolia* (53.85), *Nicotiana plumbaginifolia* (44.44), *Solanum incanum* (100.00)
Ringworm (0.961)	*Allium cepa* (100.00), *Argemone mexicana* (46.34), *Euphorbia hirta* (31.58), *Holoptelea integrifolia* (100.00), *Leonotis neopetifolia* (100.00)
Toes infection (0.962)	*Achyranthes aspera* (51.22), *Argemone mexicana* (14.63)
Wound (0.888)	*Acalypha indica* (21.43), *Acorus calamus* (44.44), *Anisomeles indica* (100.00), *Bambusa bambos* (100.00), *Butea monosperma* (13.33), *Caesulia axillaris* (22.73), *Cissampelos pareira* (14.29), *Cleome viscosa* (38.46), *Commelina benghalensis* (100.00), *Crotalaria juncea* (100.00), *Cryptolepis dubia* (62,50), *Cynodon dactylon* (35.00), *Datura stramonium* (100.00), *Dendrophthoe falcata* (100.00), *Desmostachya bipinnata* (100.00), *Dicliptera paniculata* (100.00), *Eclipta prostrata* (30.95), *Ehretia laevis* (100.00), *Eulaliopsis binata* (21.43), *Euphorbia hirta* (42.11), *Hyptis suaveolens* (16.67), *Ipomoea carnea* (26.09), *Lannea coromandelica* (20.83), *Lantana camara* (39.53), *Linum usitatissimum* (100.00), *Mallotus philippensis* (50.00), *Mitragyna parvifolia* (23.08), *Nicotiana plumbaginifolia* (22.22), *Oroxylum indicum* (25.00), *Persicaria barbata* (71.43), *Phyllanthus amarus* (28.57), *Ricinus communis* (37.66), *Scoparia dulcis* (100.00), *Sida rhombifolia* (67.44), *Typha domingensis* (100.00), *Vallaris solanacea* (100.00), *Vitex negundo* (39.66), *Wrightia arborea* (22.22)

Abbreviations: F_{ic}=Consensus factor, *FL*=Fidelity level.

significant inhibitory effects (concentration 100 μg) on the Epstein–Barr virus early antigen activation induced by the tumor promoter 12-*O*-tetradecanoylphorbol-13-acetate in Raji cells (Chakraborty et al., 2002). The leaf extract and the non-alkaloid fraction of this plant are valuable antitumor promoters in carcinogenesis (Chakraborty et al., 2002). *Achyranthes aspera* L. also has trypsin inhibitory properties (Geetha and Davuluri, 2013). The ethanol and aqueous extracts of leaves of *Achyranthes aspera* L. have shown wound healing activity in excision and incision wound models (Edwin et al., 2008). The ethanol and aqueous extracts of leaves of *Achyranthes aspera* L. showed antioxidant properties in DPPH radical scavenging and superoxide scavenging activities (Edwin et al., 2008). Antioxidant activities were also reported in leaves (Tahiliani and Kar, 2000) and seeds (Malarvili and Gomathi, 2009). The alcoholic extracts of leaves and seeds of *Achyranthes aspera* L. showed anti-inflammatory activity at the oral dose of 250 mg/kg body weight in carrageenan-induced paw edema model and formalin model in Wistar albino rats of either sex (weighing 200–250 g) (Mehta et al., 2009). Ethanolic extracts of *Achyranthes aspera* L. significantly inhibited paw edema induced by carrageenan and Freund's complete adjuvant and prevent accumulation of inflammatory cells in carrageenan-induced peritonitis at doses of 100–200 mg/kg bw (Gokhale et al., 2002). In acute and sub acute oral toxicity tests, this plant was found to be non-toxic to swiss albino mice (Table 3). Clinical trial of the plant on patients with shoth (general anasarca) (Shankar et al., 1980) and Obesity (Mangal and Sharma, 2009) showed promising results. However human clinical trial related to any skin disease has not been conducted on this plant.

Acorus calamus L. has shown wound healing, antiinflammatory, antioxidant and antimicrobial properties in the earlier studies (Tables 3 and 4). Several studies have recognized anti-inflammatory potential of *Acorus calamus* L. Rhizome extract showed anti-inflammatory property in acute, chronic and immunologic models of inflammation (Varde et al., 1988; Vohra et al., 1989), whereas leaf extract showed anti-inflammatory activity in study on human keratinocyte HaCaT cells (Kim et al., 2009). Antiinflammatory effects of *Acorus calamus* L. could be mediated by suppression of NF-κB and interferon regulatory factor 3 (IRF3) (Kim et al., 2009). Mild but acceptable toxicity of rhizome extract of this plant was observed at high doses by Muthuraman and Singh (2012). β-asarone, a compound from this plant is potentially toxic and carcinogenic (Taylor et al., 1967; Keller and Stahl, 1983), whereas α-asarone has hepatocarcinogenic and mutagenic activity in mice (Chamarro et al., 1998). β-asarone has an oral LD_{50} of 1010 mg/kg bw in rats and and i.p. LD_{50} of 184 mg/kg bw in mice (JECFA, 1981). The free radical scavenging activity of *Acorus calamus* L. has been found to be useful to overcome excess production of reactive oxygen species generated due to continuos exposure to loud noise and β-Asarone is believed to be involved in reducing the stress (Manikandan and Devi, 2005). Clinical studies on extracts of *Acorus calamus* L. on the management of depression (Tripathi and Singh, 1995), generalized anxiety disorder (Bhattacharyya et al., 2011), ischemic heart disease (Mamgain and Singh, 1994) and bronchial asthma (Rajasekharan and Srivastava, 1977) in humans have shown promising results but clinical trials related to the skin diseases are still lacking. However, *Acorus calamus* L. along with 21 other plants is part of a polyherbal Ayurvedic formulation of The Himalaya Drug Company known as "Muscle & Joint Rub", which is recommended for the topical management of acute and chronic musculoskeletal disorders. Phase III clinical trial of Muscle & Joint Rub showed that it is effective and safe in the management of muscle sprains, contusions and inflammatory musculoskeletal disorders (Rajanna and Kolhapure, 2005). Since the product studied was a combination of different plants, it is not clear what exact effect *Acorus calamus* L. had on the studied disease. Additional clinical studies are required before a firm conclusion can be made.

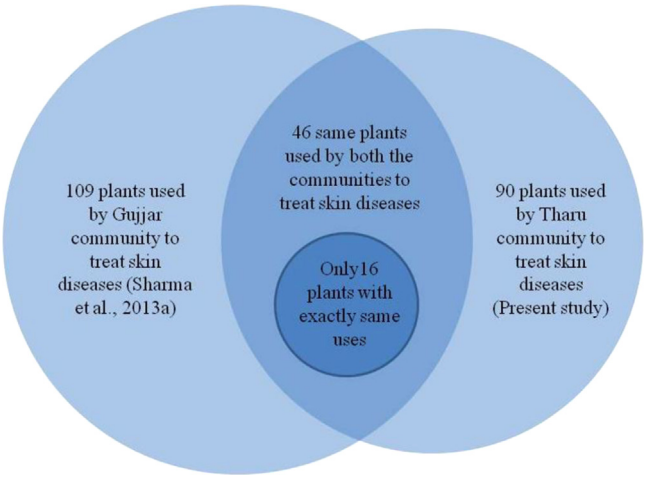

Fig. 5. Comparison between plants used to treat skin diseases by two important indigenous communities of sub-Himalayan region of Uttarakhand *viz*., Gujjar and Tharu.

Ageratum conyzoides (L.) L. has shown wound healing, antiinflammatory, antioxidant and antimicrobial properties in the earlier studies (Tables 3 and 4). Leaf extract of this plant was not toxic even at high doses of 5000 mg/kg bw in acute oral toxicity test on Wistar rats (Diallo et al., 2010). Clinical trials of aqueous extract of the whole plant was done with patients with arthrosis and results showed analgesic effect in 66% patients and improvement in articulation mobility in 24% patients without side effects (Marques-Neto et al., 1988). *Albizia lebbeck* (L.) Benth. has shown wound healing, antiinflammatory, antioxidant and antimicrobial properties in the earlier studies (Tables 3 and 4). This plant also has trypsin inhibitory properties (P. Sharma et al., 2012). Histamine plays major role in allergic diseases and its action is mediated mainly by H_1 receptor (H1R) (Nurul et al., 2011). The effect of the extract from the bark of *Albizia lebbeck* (L.) Benth. (AL) on H1R and HDC gene expression using toluene-2,4-diisocyanate (TDI) sensitized allergy model rats and HeLa cells expressing endogenous H1R was studied by Nurul et al. (2011). Their study suggested that AL alleviated nasal symptoms by inhibiting histamine signaling in TDI-sensitized rats through suppression of H1R and HDC gene transcriptions; moreover suppression of Th2-cytokine signaling by AL also suggests that it could affect the histamine–cytokine network (Nurul et al., 2011). Methanolic leaf extract of this plant was non-toxic even at a dose of 2000 mg/kg bw in acute oral toxicity study on Wistar rats (Sivakumar et al., 2013). However human clinical trial related to any skin disease has not been conducted on *Ageratum conyzoides* (L.) L. and *Albizia lebbeck* (L.) Benth.

Allium cepa L. has shown wound healing, antiinflammatory, antioxidant and antimicrobial properties in the earlier studies (Tables 3 and 4). This plant also has trypsin inhibitory properties (Deshimaru et al., 2003) as well as tyrosinase inhibitory properties (Arung et al., 2011). *Allium cepa* L. has many biologically active antifungal, antibacterial and antimicrobial compounds (Table 4) and is non-toxic orally even at high doses (Bhanot and Shri, 2010) (Table 3). Some skin care products made from extract of this plant are already available in the market. *In vivo* clinical study on thirty people with hypertrophic scars or keloids showed that topical applications of a gel containing *Allium cepa* L. extract, pentaglycan, and allantoin twice a day for 24 weeks is useful in reducing neoangiogenesis in hypertrophic scars and keloids, resulting in clinical improvement of skin lesions (Campanati et al., 2010).

Table 3
Earlier studies showing wound healing, toxicological, antioxidant and tyrosinase inhibitory properties of the plants recorded in the present study.

Plant species	Wound healing studies		Toxicological studies		Antioxidant activities	Tyrosinase inhibitory activities
	Plant part; Application; Extract; Animal (Weight)	**Animal Model; Reference control; Effective treatment [Source for columns 2 & 3]**	**Plant part; Extract; Animal (Weight)**	**Animal model (Dose); Toxicity status [Source for columns 4 & 5]**		
Acalypha indica L.	Whole plant; Topical application; 10% (w/v) alcoholic extract; Lewis Wistar albino rats of either sex (100–200 g)	EWM, IWM; NA; 10% (w/v) alcoholic extract (Reddy et al., 2002)	Whole plant; Ethanolic; Male Wistar albino rat (150 to 200 g)	AOTS (5, 50, 300, 500 and 2000 mg/kg bw), SATS (100,200,300,400, and 500 mg/kg/day bw); NT/NM (Sathya et al., 2012)	Aqueous (IC_{50}=527.86 μg/ml), methanol (IC_{50}=483.87 μg/ml), hexane (IC_{50}=805.27 μg/ml) and chloroform (IC_{50}=1688.00 μg/ml) extracts of whole plant showed DPPH radical scavenging activity (Guha et al., 2011).	NE
Achyranthes aspera L.	Leaves; Topical application; 2.5%, 5% and 10% (w/w) methanolic extract; Albino rats of either sex (200–250 g)	EWM, IWM; 1% SSD; 5% and 10% (w/w) methanolic extract (Fikru et al., 2012)	Leaves; Methanolic; Swiss mice (35 to 45 g)	AOTS (2, 4, 6 and 8 gm/kg bw); NT/NM (Sadashiv and Krishna, 2011)	Aqueous (IC_{50}=179.35 μg/ml), methanol (IC_{50}=291.92 μg/ml), hexane (IC_{50}=559.32 μg/ml) and chloroform (IC_{50}=652.60 μg/ml) extracts of whole plant showed DPPH radical scavenging activity (Guha et al., 2011).	NE
			Whole Plant; Methanolic; Swiss albino mice (20–25 g)	AOTS (150, 200, 250 mg/kg bw), SATS (25 and 50 mg/kg/day bw); NT/NM (Reddy and Kamble, 2014)		
Acorus calamus L.	Leaves; Topical application; 40% and 20% (w/w) ethanolic extract; Rats of either sex (NA)	EWM, IWM; PIO; 20% (w/w) ethanolic extract (Jain et al., 2010)	Rhizome; Hydroalcoholic; Mice (either sex, 20–30 g) and Wistar rats (either sex, 200–230 g)	AOTS (2500, 5000, 7500 and 10000 mg/kg bw), SATS (200 to 1000 mg/kg bw); NT/NM but mild and acceptable toxicity potential at high dose (Muthuraman and Singh, 2012)	Rhizome showed antioxidant activities in DPPH (IC_{50}=79.9 μM trolox/100 g dw), ABTS (IC_{50}=8.66 μM trolox/100 g dw) and FRAP (IC_{50}=78.9 μM trolox/100 g dw) assays (Wojdylo et al., 2007). Methanol extract of leaf (IC_{50}=20 μg/ml) and rhizome (IC_{50}=20.8 μg/ml) showed activity in DPPH assay, methanol extract of leaf (IC_{50}=100.0 μg/ml) and rhizome (IC_{50}=30.5 μg/ml) showed Superoxide anion–scavenging activity, methanol extract of leaf (IC_{50}=18.8 μg/ml) and rhizome (IC_{50}=33.3 μg/ml) showed ability of chelating ferrous ion (Devi and Ganjewala, 2011).	NE
			Rhizome; Ethanolic; Female Wistar rats (150–200 g) and Wistar albino rats of either sex (100–190 g)	AOTS (175 to 5000 mg/kg), CTS (200 to 600 mg/kg bw for 60 days); NT/NM (P.D. Shah et al., 2012)		
Ageratum conyzoides (L.) L.	Leaves; Topical application; 10% (w/w) petroleum ether, chloroform, methanolic and aqueous extracts; Wistar albino rats of either sex (150–250 g)	EWM (normal and infected), IWM, DSW; 0.2% (w/w) NFZ; Methanolic and aqueous extracts (Dash and Murthy, 2011a)	Leaf; Hydroalcoholic; Wistar rats of either sex (150–200 g)	AOTS (5000 mg/kg bw), SATS (500 and 1000 mg/kg bw); NT/NM (Diallo et al., 2010)	Whole plant methanol extract (IC_{50}=22.50 μg/ml) and essential oil (IC_{50}=570 μg/ml) showed activity in DPPH assay, whole plant methanol extract (IC_{50}=1290.00 μg/ml) and essential oil (IC_{50}=15.50 μg/ml) showed Lipid peroxidases activity, whole plant methanol extract (IC_{50}=4.48 mg/ml) and essential oil (IC_{50}=570 mg/ml) showed activity in FRAP assay (Patil et al., 2010).	NE
			Whole plants; Alcoholic; Swiss albino mice (25–30 g) and Wistar albino rats of the both sexes (150–200 g)	AOTS (0.5, 1.0, 2.0, 3.0 and 4.0 g/kg bw); NT/NM (M.A. Rahman et al., 2012)	Crude ethanolic extract of leaves at the concentration of 100 μg/ml showed 91.72% inhibition in DPPH free radical scavenging assay (IC_{50}=18.91 μg/ml), ethanolic leaf extracts exhibited 2.011 average absorbance at 700 nm at 100 μg/ml concentrations in Reducing power assay, Ethanolic leaf extracts showed 76.0393% chelating ability at 100 μg/ml	

					concentration (IC_{50}=16.28 μg/ml) in Ferrous ion chelating ability (Dewan et al., 2013).	
Albizia lebbeck (L.) Benth.	Bark; Topical application; 5% and 10% (w/v) aqueous and ethanolic extracts and Oral application: 250 mg/kg and 500 mg/kg bw; Wistar rats (150–200 g)	EWM, IWM, DSW; 5% (w/w) PVI; 10% (w/v) ethanolic extract (Upadhyay et al., 2013)	Leaves; Methanolic; Wistar rats (150–200 g)	AOTS (2000 mg/kg bw); NT/NM up to 2000 mg/kg bw (Sivakumar et al., 2013)	Activities of antioxidant enzymes, such as superoxide dismutase (SOD), catalase (CAT), glutathione peroxidase (GPX) and glutathione S transferase (GST) were assessed in Male albino rats (Sprague–Dawley strain weighing 120–150 g) using aqueous extract of leaves. The activities of these enzymes returned to normalcy in all administered rats (Resmi et al., 2006).	NE
Allium cepa L.	Bulbs; Oral application; 300 mg/kg bw ether, chloroform, alcoholic and chloroform–water extracts; Wistar albino rats of either sex (150–200 g)	EWM, IWM, DSW; NA; Alcoholic extract (Shenoy et al., 2009a)	Dry skin and edible portion of bulbs; Methanolic; Swiss albino mice (25–35 g) of either sex	AOTS; NT/NM (Bhanot and Shri, 2010)	Ethyl acetate fraction of Red onion peel was studied. Antioxidant activity (AOA) was 97.4% as performed by autoxidation of β–carotene and linoleic acid coupled reaction method, free radical scavenging activity (FRSA) was 75.3% as measured by using DPPH radical solution, Reducing power was 1.6 ascorbic acid equivalents per milligram as determined by ferric reducing antioxidant power assay (B.N. Singh et al., 2009). Free radical scavenging activities (FRSA) in different layers ranged with IC_{50} values from 0.1 to 15.2 mg/ml (Prakash et al., 2007).	Quercetin 4′-*O*-*β*-D-glucopyranoside from dried skin showed IC_{50} value of 4.3 and 52.7 μM using L-tyrosine or L-DOPA as a substrate (Arung et al., 2011).
Amaranthus spinosus L.	Leaves; Topical application; Benzene and alcoholic extracts; Rats	EWM, DSW, IWM; Benzene and alcoholic exract (S.G. Kumar et al., 2009)	Leaves; Ethanolic; Wistar albino rats of both sex (200–250 g)	AOTS (5, 50, 300 and 2000 mg/kg bw); NT/NM up to 2000 mg/kg bw (S.B. Mishra et al., 2012)	DPPH (IC_{50}=87.50 μg/ml), superoxide (IC_{50}=98.80 μg/ml), hydroxyl (IC_{50}=106.25 μg/ml), nitric oxide (IC_{50}=88.70 μg/ml) and ABTS (IC_{50}=147.50 μg/ml) radical scavenging activities were reported in methanol extract of leaves (B.S.A. Kumar et al., 2010). DPPH (IC_{50}=29 μg/ml), scavenges suproxide (IC_{50}=66–70 μg/ml), hydrogen peroxide (IC_{50}=120–125 μg/ml), hydroxyl radicals (IC_{50}=140–145 μg/ml) and nitric oxide (IC_{50}=135–140 μg/ml) activities were reported in 50% ethanolic extract of whole plant (Zeashan et al., 2009).	NE
Anisomeles indica (L.) Kuntze	NE	NE	Aerial parts; Ethyl acetate and chloroform; Male and female Wistar rats (200–250 g)	AOTS (2000 mg/kg bw); NT/NM (Sundriyal et al., 2013)	Methanol extract of whole plant showed dose dependant free radical scavenging activity at concentrations of 0.05 to 1.0 mg/ml in DPPH free radical assay (Huang et al., 2012).	Purified Ovatodiolide from whole plant inhibited mushroom tyrosinase activity (IC_{50}=0.253 mM), intracellular tyrosinase activity (IC_{50}=0.469 mM) and decreased the amount of melanin (IC_{50}=0.435 mM) in B16F10 cells. Methanol extract of whole plant showed minor inhibitory effects on melanogenesis in B16F10 melanoma on intracellular tyrosinase activity and melanin content in B16F10 cells (Huang et al., 2012).
Annona squamosa L.	Leaves; Topical application; Ethanol extract (100 mg/kg bw); Streptozotocin-nicotinamide-induced diabetic rats	EWM (open); No reference control; Ethanolic extract	Seed; Crude extracts; Albino female Wistar rats (100–120 g)	AOTS (2000 mg/kg bw); 300 mg/kg bw is NT/NM, whereas 2000 mg/kg bw was toxic (Aneela et al., 2011)	Ethanolic extract of leaves showed 99.07%, 89.77% and 73.64% values in ABTS, DPPH and nitric oxide radical	NE

Table 3 (*continued*)

Plant species	Wound healing studies		Toxicological studies		Antioxidant activities	Tyrosinase inhibitory activities
	Plant part; Application; Extract; Animal (Weight)	**Animal Model; Reference control; Effective treatment [Source for columns 2 & 3]**	**Plant part; Extract; Animal (Weight)**	**Animal model (Dose); Toxicity status [Source for columns 4 & 5]**		
		(Ponrasu and Suguna, 2012)			scavenging activity at 1000 μg/ml concentration (Shirwaikar et al., 2004).	
Argemone mexicana L.	Leaves; Topical application; Petroleum ether, chloroform, methanolic and aqueous extracts; Wistar albino rats of either sex (150–250 g)	EWM (normal and infected), IWM, DSW; 0.2% (w/w) NFZ; Methanolic and aqueous extracts (Dash and Murthy, 2011b)	Root bark; Aqueous; Swiss mice of both sexes	AOTS (3, 5, 7 gm/kg bw); NT/NM even at high dose (Pingale, 2013)	Ethanolic extract of roots possesses antioxidant activity at a dose of 100 μg/ml concentration, the extract showed high scavenging activity against DPPH (85.17%), ABTS (75.27%) and H_2O_2 (84.25%) radicals (Perumal et al., 2010).	NE
			Whole plant; Crude extract; Mice (18–25 g)	AOTS; Toxic with LD_{50} value of 400 mg/kg bw (Ibrahim and Ibrahim, 2009)	Leaves extracts showed superoxide anion scavenging activity in Nitro blue tetrazolium assay with maximum free radical scavenging at a dosage of 200 μg/ml (Bhardwaj et al., 2011).	
Azadirachta indica A. Juss.	Leaves; Topical application; 5% (w/w) ethanolic extracts; Wistar albino rats of either sex (180–200 g)	EWM; 5% (w/w) PVI; Ethanolic extract (Purohit et al., 2013)	Stem bark; Ethanolic; Male albino rats of Wistar strains (174.40 ± 12.30)	AOTS (50,100, 200 and 300 mg/kg bw); only 50 mg/kg bw relatively safe other doses toxic (Ashafa et al., 2012)	Reducing power of bark extracts at 10 mg/ml concentration: 1.710 (80% ethanol extract), 1.460 (80% Methanol extract), 1.460 (80% Acetone extract) (Sultana et al., 2007).	Methanolic extract of leaf showed 38.3% Tyrosinase inhibition in mushroom tyrosinase inhibitory activity (Adhikari et al., 2008).
			Seed oil; Three generation study on rats of either sex.	Feed on diet with 10% oil; NT/NM (Chinnasamy et al., 1993)	DPPH radical scavenging activity was recorded as 82.45%, 8.89%, 83.73%, 91.03%, 93.11% for methanol crude, Hexane, Ethyl acetate, n-Butanol and Water extracts of bark respectively, whereas DPPH radical scavenging activity was recorded as 12.56%, 9.00%, 15.00%, 33.25%, 5.83% for methanol crude, Hexane, Ethyl acetate, n-Butanol and Water extracts of leaf respectively (Ghimeray et al., 2009). Hydroxyl (OH) radical scavenging activity was recorded as 87.84%, 84.89%, 86.38%, 87.87% and 92.12% for methanol crude, Hexane, Ethyl acetate, n-Butanol and Water extracts of bark respectively, whereas Hydroxyl (OH) radical scavenging activity was recorded as 36.47% (Methanol crude), 36.17% (Hexane), 38.72% (Ethyl acetate), 35.72% (n-Butanol), 43.86% for methanol crude, Hexane, Ethyl acetate, n-Butanol and Water extracts of leaf respectively (Ghimeray et al., 2009).	
Bambusa bambos (L.) Voss	Leaves; Topical application; 0.5% and 1% (w/w) petroleum ether, chloroform and methanolic extracts; Albino rats of either sex (230 g)	EWM, IWM; 5% (w/w) FRA; Methanolic extract (Muniappan et al., 2014)	Leaves; Aqueous; Swiss albino mice of either sex (20 to 25 g)	AOTS (400, 800, 1000, 1200 mg/kg bw); NT/NM up to 1000 mg/kg bw (Kundu et al., 2011)	Aqueous, methanolic and butanolic extract of leaves showed DPPH radical scavenging activity with IC_{50} values of 964, 273 and 1103 μgm/ml (Macwan et al., 2010).	NE
Bauhinia variegata L.	Root; Topical application; Ethanolic and aqueous extracts	EWM, IWM; FRA; Methanolic and	Root; Aqueous and ethanolic; Wistar		Root water (IC_{50}=37.73 μ/ml), Root alcohol (IC_{50}=36.01 μ/ml), stem water	NE

	(200 and 400 mg/kg bw); Albino Wistar rats	ethanolic extract (Sharma, 2010)	albino rats of either sex (150–200 g)	AOTS (200, 400, 2000 mg/kg bw); NT/NM up to 2000 mg/kg bw (R.K. Sharma et al., 2011)	IC_{50}=45.85 μ/ml), stem alcohol (IC_{50}=30.50 μ/ml) extracts showed DPPH free radical scavenging activity, Root water (IC_{50}=478.80 μ/ml), Root alcohol (IC_{50}=415.20 μ/ml), stem water IC_{50}=405.80 μ/ml), stem alcohol (IC_{50}=362.90 μ/ml) showed Nitric oxide free radical scavenging activity, Root water (IC_{50}=502.10 μ/ml), Root alcohol (IC_{50}=445.30 μ/ml), stem water IC_{50}=481.30 μ/ml), stem alcohol (IC_{50}=414.60 μ/ml) also showed super oxide free radical scavenging activity, Root water (IC_{50}=11.74 μ/ml), Root alcohol (IC_{50}=10.78 μ/ml), stem water IC_{50}=10.23 μ/ml), stem alcohol (IC_{50}=9.85 μ/ml) showed Hydrogen peroxide free radical scavenging activity (Rajani and Ashok, 2009).	
			Leaves; Methanolic; Female Swiss albino mice and Wistar rats of either sex	AOTS (300 and 2000 mg/kg bw), Repeated dose toxicity (1000 mg/kg/day bw for 28 days); NT/NM in both tests (Kulkarni and Warrier, 2012)		
Boerhavia diffusa L.	NE	NE	Leaves; Aqueous; Male Wistar albino rats (104–214 g) and albino mice (18.2–24.5 g)	AOTS (2000 mg/kg bw), SATS (500, 1000 and 2000 mg/kg bw); NT/NM in both tests (Orisakwe et al., 2003)	Aqueous (IC_{50}=200.82 μg/ml), Methanolic (IC_{50}=327.40 μg/ml), Chloroform (IC_{50}=409.81 μg/ml), hexane (IC_{50}=2351.60 μg/ml) extracts of whole plant showed DPPH radical scavenging activity (Guha et al., 2011).	NE
Brassica juncea (L.) Czern.	Leaves; Topical application; 200 mg/kg petroleum ether, chloroform, ethanolic and aqueous extracts; Male Wistar albino rats (180–200 g)	EWM; 5% (w/w) PVI; aqueous extract (Malan et al., 2011)	Leaves; Petroleum ether, chloroform, ethanol and water; Sprague Dawley rats	Acute dermal toxicity-fixed dose method (1000–2000 mg/kg bw topically); NT/NM (Malan et al., 2011)	BuOH fraction of leaf controls glucose metabolism and reduces lipid peroxidation as well as the level of oxygen radicals in rats with streptozotocin-induced diabetes (Kim et al., 2003).	NE
Buchanania cochinchinensis (Lour.) M. R.Almeida	Fruits; Oral administration; 300 mg/kg po ethanolic extracts; Albino rats of either sex (150–200 g)	EWM, IWM, DSW; 0.17 mg/kg DXM; Ethanolic extract (Chitra et al., 2009)	Seed; Methanolic; Female Swiss albino mice (25–30 g)	AOTS (50, 300 and 2000 mg/kg bw); NT/NM (Singh and Bothara, 2012)	Ferric reducing antioxidant power (FRAP) at 500 μg/ml of methanol extracts of bark is 49.05 mg GAE/g of extracts (Venkata et al., 2012).	NE
			Kernels; Methanolic; Wistar rats of either sex (150–200 g)	AOTS (2000 mg/kg bw); NT/NM (Warokar et al., 2010)		
Butea monosperma (Lam.) Taub.	Bark; Topical and oral applications; 25 mg/kg bw and 50 mg/kg bw ethanolic extract; Wistar albino rats (150 to 200 g)	EWM, IWM, DSW; SOF; Flavonoid fraction from the ethanolic extract (Muralidhar et al., 2013)	Seed; Powder suspension; Charles Foster strain albino rats of either sex (180–220 g)	CTS (800 mg/kg/day bw powder suspension given orally for 90 days); Toxic effect when administered in powder form (Donga et al., 2011)	Ethyl acetate (EC_{50}=15.44 μg/ml) and butanol (EC_{50}=41.53 μg/ml) fractions showed DPPH free radical scavenging activity, whereas aqueous fractions showed no inhibition (Lavhale and Mishra, 2007).	NE
	Bark; Topical application; 200 μL of alcoholic extract; Male albino Wistar rats (150–200 g)	EWM, IWM; NA; NA (Sumitra et al., 2005)			DPPH free radical scavenging activity of Hydromethanol extract of leaves showed IC_{50} value of 25.96 μg/ml (Hasan et al., 2009).	
Caesulia axillaris Roxb.	NE	NE	Essential oil; Mice (30 g)	Essential oil from 0.05 to 0.5 ml were orally given; LD_{50} value was calculated as 9166.6 μl/kg bw (S.B. Mishra et al., 2012)	Essential oil showed DPPH radical scavenging activity with IC_{50} value of 18 μl/ml (S.B. Mishra et al., 2012).	NE
Callicarpa macrophylla Vahl	NE	NE	NE	NE	NE	NE
Calotropis procera		EWM; NA; Latex (Rasik et al., 1999)	Root barks; Aqueous and hydroalcoholic;	AOTS (2000 mg/kg bw both extract), SATS (20 mg/kg/day bw aqueous extract	Methanol extract of leaves showed DPPH free radical scavenging activity with EC_{50}	NE

Table 3 (*continued*)

Plant species	Wound healing studies		Toxicological studies		Antioxidant activities	Tyrosinase inhibitory activities
	Plant part; Application; Extract; Animal (Weight)	**Animal Model; Reference control; Effective treatment [Source for columns 2 & 3]**	**Plant part; Extract; Animal (Weight)**	**Animal model (Dose); Toxicity status [Source for columns 4 & 5]**		
(Aiton) Dryand.	Latex; Topical application; 1.0% sterile solution; Male Guinea Pigs of Swiss strain (NA)		Male and female NMRI mice (27 ± 4 g) and Wistar rats of either sex (160 ± 42 g)	for 3 and 6 weeks); Aqueous extract relatively safe as compared to hydroalcoholic extract (Ouedraogo et al., 2013).	value of 110.25 μg/ml (Yesmin et al., 2008).	
			Latex; Fed through diet; Black rat, *Rattus rattus*.	Toxicity study (concentrations of 5, 7.5 and 10% w/w); Toxic (Pahwa and Chatterjee, 1988)	DPPH free radical scavenging activities of methanol extract of stem was 93% at 1.3 ml concentration and leaf was 88% at 1.5 ml concentration (Patel et al., 2010).	
Cannabis sativa L.	NE	NE	Leaves; Aqueous, alcoholic and chloroform; Female Wistar albino rats (120 to 170 g)	AOTS; NT/NM up to 4000 mg/kg bw (Zade et al., 2013)	Showed 5% inhibition of DOPA auto-oxidation at concentration of 500 μg/ml (Lee et al., 1997).	Whole plant extract showed 3% inhibition of tyrosinase at concentration of 333 μg/ml (Lee et al., 1997).
			Seed oil; direct; Wistar albino rats of different sex (100–150 g)	Toxicity study (Orally at daily doses of 0.01, 0.1 and 1 ml/kg/day bw); Toxic (Dahab et al., 2013)		
Cassia fistula L.	Leaves/Topical application: alcoholic extract	Albino rat (NA): NA; NA; NA (Senthilkumar et al., 2006b)	Seed; Methanolic; Mice	AOTS (5000 mg/kg bw); NT/NM (Jothy et al., 2011)	Ethanol extracts of leaves and methanol extracts of stem bark, pulp and flowers showed moderate antioxidant activity in linoleic acid peroxidation system between 37 and 62% at concentration of 0.2 mg/ml (Siddhuraju et al., 2002).	Methanol extract of pods showed tyrosinase inhibitory activity with IC_{50} value of 39.2 μg (Khan et al., 2013).
			Pod pulp; direct; Rats and mice	AOTS; NT/NM (Sakulpanich et al., 2012)	Stem bark (93%), leaves (74.9%), BHT (37.8%), flowers (33.2%) and pulp (15.7%) extracts showed DPPH radical scavenging activity (Siddhuraju et al., 2002).	
			Stem bark; Alcoholic; Rats	AOTS (2000 mg/kg bw); NT/NM (Agnihotri and Singh, 2013)		
Celastrus paniculatus Willd.	Leaves; Topical application; Petroleum ether extract (8 mg/ml of 0.2% sodium alginate gel); Swiss albino rats (175–225 g)	EWM, IWM, DSW; NFZ; Triterpene compound lupeol from petroleum ether extract (Harish et al., 2008)	Whole Plant; Methanolic; Swiss albino mice (18–22 g) and Wistar albino rats (150–180 g) of either sex	AOTS (2000 mg/kg bw); NT/NM (Atigari et al., 2012)	Aqueous, chloroform, and methanolic extracts of the seeds showed 99%, 95.2%, 92% inhibition respectively in DPPH radical scavenging assay, whereas chloroform, methanolic and aqueous extracts seeds demonstrated 806.5 μmol Trolox/g extract, 705.25 μmol Trolox/g extract, 609.5 μmol Trolox/g extract ABTS scavenging activity respectively in Trolox equivalent antioxidant capacity (TEAC) assay (Arora and Pandey-Rai, 2014).	NE
			Seeds; Ethanolic and methanolic; Albino mice (25–32 g)	AOTS (1000 and 5000 mg/kg bw); NT/NM (Parimala et al., 2009)		
					Chloroform, methanolic and aqueous extracts of seed showed FRAP value of 245 μmol Fe(II)/g extract, 211.11 μmol Fe (II)/g and 210 μmol Fe(II)/g extract respectively in Ferric reducing antioxidant power assay (FRAP),	

					whereas aqueous, methanolic and chloroform extract showed 52.8%, 43.7 ± 2.85% and 42.98% inhibition in Lipoxygenase inhibition assay (Arora and Pandey-Rai, 2014).	
Chrysopogon zizanioides (L.) Roberty	NE	NE	Root; Methanolic; Wistar albino rats (200–220 g) of either sex	AOTS (5000 mg/kg bw); NT/NM (Parmar et al., 2008)	DPPH activity, Total antioxidant capacity (TAC), Reducing Power (RP), Ferrric reducing antioxidant powder assay (FRAP) power increased with the increase in concentration of the extracts (Luqman et al., 2009).	Essential oil markedly decreased tyrosinase activity in α-melanin-stimulating-hormone stimulated B16 cells (Peng et al., 2014).
			Oil; direct; Albino mice of either sex (20–25 g) and Albino rats of either sex (150–225 g)	AOTS (884, 1250, 1768, 2500, 3536 and 5000 mg/kg bw), SATS (100, 250, 500 and 1500 mg/kg/day bw); NT/NM in Both tests, LD_{50} value 2985.38 mg/kg bw (Tripathi et al., 2006)	Vetiver oil (10 μL/ml) dissolved in methanol exhibited ~93% free radical scavenging activity in the DPPH assay and ~34% Fe^{2+} chelating activity in the metal chelating assay (Kim et al., 2005).	
Cissampelos pareira L.	NE	NE	Whole plant; Hydroethanolic; Rats	AOTS (2 g/kg bw), SATS (1 and 2 g/kg/day bw); NT/NM in Both tests (Amresh et al., 2008)	DPPH free radical scavenging activity of the alkaloidal fraction of roots showed IC_{50} value of 63.44 μg/ml (Bafna and Mishra, 2010). 50% ethanol extract of roots showed significant antioxidant activity in the DPPH assay and was found to significantly scavenge superoxide, hydrogen peroxide, hydroxyl radicals, and nitric oxide at a dose regimen of 50 to 400 μg/kg *in vitro* (Amresh et al., 2007a).	NE
Cleome viscosa L.	Leaves and whole plant; Topical application; 5% and 10% (w/w) methanolic extract; Wistar albino rats of either sex (130–180 g)	EWM, IWM; 0.2% (w/w) NEO; 5% (w/w) methanolic extract (Mohammad and Mazumder, 2013)	Leaves and whole plant; Ethanolic; Wistar albino rats of either sex	AOTS (2 g/kg bw); NT/NM (Panduraju et al., 2011)	70% methanolic extract of leaves showed high free radical scavenging activity in DPPH (IC_{50} = 373.18 μg/ml) and hydroxyl radical (IC_{50} = 573.55 μg/ml) assays (Gupta et al., 2011).	Ethanolic extract of leaf at 200 μg/ml concentration showed 31.47% inhibition in tyrosinase inhibitory activity using DOPA chrome method (Meechai et al., 2010).
Clerodendrum infortunatum L.	NE	NE	Leaves; Methanolic; Adult male Swiss albino mice (18–25 g)	AOTS (2000 mg/kg bw), SATS (500 mg/kg bw); NT/NM (Das et al., 2011)	Ethanol extract of leaves showed DPPH scavenging activity of 92.6% at 250 μg/ml concentration, whereas chloroform and petroleum ether extracts showed 52.2% and 16.7% inhibition at the same concentration. Ethanol extract of leaves exhibited 68.58%, 62.06% and 52.65% hydroxyl, superoxide anion and nitric oxide radical activity at 250 μg/ml respectively (Gouthamchandra et al., 2010).	NE
Commelina benghalensis L.	Root; Topical application; alcoholic and aqueous extracts; Albino rats (NA)	EWM, IWM, DSW; NA; NA (Sambrekar et al., 2011)	Leaves; Hydroethanolic; Wistar albino female rats (130–150 g)	AOTS (2000 mg/kg bw), SATS (200 and 400 mg/kg/day bw for 14 days); NT/NM in both tests (Tiwari et al., 2013)	Methanol extract of aerial part exhibited strong DPPH radical scavenging activities (IC_{50} = 138.7 μg/ml) (Anusuya et al., 2012).	NE
Crotalaria juncea L.	NE	NE	Leaves; Ethanolic; Male albino Wistar rats (150–250 g)	AOTS (2000 mg/kg bw); NT/NM (Ashok et al., 2006)	Seed oil showed IC_{50} value of 122.52 μg/ml for the DPPH radical scavenging activity and IC_{50} value of 286.409 μg/ml for hydroxyl radical scavenging activity (Chouhan et al., 2011).	NE
Cryptolepis dubia (Burm. f.) M.R. Almeida	NE	NE	Leaves and whole plant; Mice, rat and rabbit	AOTS (0.324, 0.31, 0.356 g/kg bw); NT/NM (Minh and Tuan, 2013)	NE	NE
	Tubers; Topical application; 200 and 400 mg/kg bw petroleum	EWM; 0.2% (w/w) NFZ; 200 mg/kg			Methanolic extract enhanced the antioxidant defense against reactive	NE

Table 3 (*continued*)

Plant species	Wound healing studies		Toxicological studies		Antioxidant activities	Tyrosinase inhibitory activities
	Plant part; Application; Extract; Animal (Weight)	**Animal Model; Reference control; Effective treatment [Source for columns 2 & 3]**	**Plant part; Extract; Animal (Weight)**	**Animal model (Dose); Toxicity status [Source for columns 4 & 5]**		
Curculigo orchioides Gaertn.	ether, chloroform, ethyl acetate and methanolic extracts; Wistar albino rats (150–200 g)	methanolic extract (Agrahari et al., 2010a)	Rhizome; Hydroalcoholic; Wistar rats	AOTS (50, 100, 300, 1000, and 2000 mg/kg bw); NT/NM up to 2000 mg/kg bw (Asif and Kumar, 2010)	oxygen species produced under hyperglycemic conditions (Anandakirouchenane et al., 2013). Hydroxyl radical scavenging activities were reported in eight compounds isolated from rhizome *viz*., Orcinol glucoside (IC_{50}=1.39 mM), orcinol-1-O-β-D-glucopyranosyl-(1→6)- β-D-glucapyranoside (IC_{50}=0.87 mM), orcinol-1-O- β-D-apiofuranosyl-(1→6)-β-D-glucopyranoside (IC_{50}=1.17 mM), curculigoside (IC_{50}=0.54 mM), curculigoside B (IC_{50}=1.11 mM), curculigoside C (IC_{50}=0.25 mM), 2,6-dimethoxyl benzoic acid (IC_{50}=1.51 mM) and syringic acid (IC_{50}=2.61 mM) (Wu et al., 2005). Superoxide anion radical scavenging activities were reported in eight compounds isolated from rhizome *viz*., Orcinol glucoside (IC_{50}=2.49 mM), orcinol-1-O-β-D-glucopyranosyl-(1→6)-β-D-glucapyranoside (IC_{50}=1.56 mM), orcinol-1-O- β-D-apiofuranosyl-(1→6)-β-D-glucopyranoside (IC_{50}=1.84 mM), curculigoside (IC_{50}=1.35 mM), curculigoside B (IC_{50}=1.48 mM), curculigoside C (IC_{50}=0.88 mM), 2,6-dimethoxyl benzoic acid (IC_{50}=3.21 mM) and syringic acid (IC_{50}=3.46 mM) (Wu et al., 2005).	
Cuscuta reflexa Roxb.	NE	NE	Stem; Aqueous and alcoholic; Albino mice of either sex (16–20 g)	AOTS (2000 mg/kg); NT/NM (Katiyar et al., 2012)	Methanolic extract showed DPPH radical scavenging activity with IC_{50} value of 359.48 μg/ml (Vijikumar, 2011). Alcoholic extract showed DPPH radical scavenging activity with IC_{50} value of 6.89 mg/ml (Sakshy et al., 2012).	Methanolic extract of whole plant showed 28.9% Tyrosinase inhibition in mushroom tyrosinase inhibitory assay (Adhikari et al., 2008).
Cynodon dactylon (L.) Pers.	Whole plant; Topical application; 11.5% (w/w) hydroalcoholic extract; Male Wistar albino rats (180–200 g)	EWM; PVI; Hydroalcoholic extract (Kumar and Kashyap, 2013)	Whole plant; Chloroform, ethanolic extract; Mice	AOTS (100–2000 mg/kg bw); NT/NM (Yogesh et al., 2013)	Methanolic leaf extracts showed total antioxidant capacity of 10.48 μg/ml AAE in phosphomolybdenum method, with reducing power of 0.726 (Krishanti et al., 2010). Water (IC_{50}=152.96 mg/L), methanol (IC_{50}=203.29 mg/L) and acetone (IC_{50}=206.69 mg/L) extracts of whole plants showed activity in DPPH free radical assay, whereas water (IC_{50}=57.21 mg/L) and acetone	NE

					(IC_{50} = 179.77 mg/L) showed activity in ABTS assay (Khlifi et al., 2013).	
Dalbergia sissoo DC.	NE	NE	Bark; Alcoholic extract; Wistar rats	AOTS (50, 100, 300, 1000, and 3000 mg/kg bw); NT/NM up to dose of 3000 mg/kg bw (Mojahid-ul-Islam and Elhddad, 2012)	Aqueous (IC_{50} = 12.23 μg/ml) and methanol (IC_{50} = 23.63 μg/ml) extract of the stem bark showed DPPH radical scavenging activity (Roy et al., 2011).	NE
Datura stramonium L.	NE	NE	Seeds; Alkaloids; Male and female Albino Wistar rats	AOTS; NT/NM (Abdelouahab et al., 2011)	Leaf extract showed free lipid peroxidation activity with IC_{50} value of 1.45 mg/ml (Kumar et al., 2008).	NE
Dendrophthoe falcata (L.f.) Ettingsh.	NE	NE	Leaves; Ethanolic; Swiss albino mice of either sex (20–25 g)	Brine shrimp lethality assay for general toxicity; Low level of general toxicity (LC50 100 μg/ml) (Hasan et al., 2006)	Ethanolic extract of aerial parts showed potent antioxidant activity by lipid peroxidation inhibition, reduced glutathione, superoxide dismutase levels and increased the catalase activity (Pattanayak and Sunita, 2008).	NE
Desmodium gangeticum (L.) DC.	NE	NE	Aerial parts; Petroleum ether, benzene, chloroform, acetone and alcohol; Healthy albino Wistar rats (200–250 g)	AOTS (2000 mg/kg bw); NT/NM (Bisht and Bhattacharya, 2013)	Ethanolic extract of leaves showed potent antioxidant activity in DPPH, superoxide scavenging, reducing power, nitric oxide scavenging, 2,2 azino-bis(3-ethylbenzothiazoline-6-sulfonate), hydroxyl radical, ferric reducing antioxidant power and chelating ability assays (Venkatachalam and Muthukrishnan, 2012). Hydroalcoholic extract of the aerial parts strongly scavenged DPPH radical with the IC_{50} being 2.01 mg/ml, total antioxidant capacity of the extract was 149.91 nmol ascorbic acid/g, extract inhibited the ferrylbipyridyl (chromogen) formation in a dose dependent fashion with the IC_{50} value of 0.115 mg/ml (Govindarajan et al., 2003).	NE
Desmostachya bipinnata (L.) Stapf	NE	NE	Roots; Alcoholic and aqueous; Female albino mice (20–30 g)	AOTS (2000 mg/kg bw); NT/NM (Hegde et al., 2010)	Hydroalcoholic extract showed significant antioxidant activity in a dose-dependent manner with an IC_{50} value of 264.18 μg/ml in H_2O_2 scavenging assay (Golla and Bhimathati, 2014).	NE
Dicliptera paniculata (Forssk.) I. Darbysh.	NE	NE	Leaves and stem; Aqueous, methanol and butanolic; Wistar rats (150–250 g)	AOTS (10 to 5000 mg/kg bw); NT/NM up to 5000 mg/kg bw (Abdulazeez et al., 2010)	NE	NE
Eclipta prostrata (L.) L.	NE	NE	Whole plant; Ethanolic; Swiss albino mice and Wistar albino rats	AOTS (0.5, 1.0, 2.0, 3.0 and 4.0 g/kg bw); NT/NM up to 4 g/kg bw (Md.A. Rahman et al., 2012)	Trolox equivalent antioxidant capacity TEAC of methanolic and aqueous extracts of aerial parts was 54.3 μmol trolox/100 g DW and 148.1 μmol trolox/100 g DW (Cai et al., 2004).	NE
Ehretia laevis Roxb.	NE	NE	NE	NE	Ethanol extract of leaves and stem showed DPPH radical scavenging activity with IC_{50} values of 2.44 and 29.88 μg/ml respectively (Torane et al., 2011).	NE
Eulaliopsis binata (Retz.) C.E.Hubb.	NE	NE	NE	NE	NE	NE
Euphorbia hirta L.	Whole plant; Topical application; 2% (w/w) ethanolic extract; Male Wistar albino rats (150–200 g):	BWM; 0.2% (w/w) NFZ; 2% w/w ethanolic extract (Chandramohan and Reddy, 2006)	Fruits; Ethanolic and aqueous suspended in 0.5% w/v Sodium-CMC; Adult Swiss albino mice (20–25 g)	AOTS (1000, 2000, 3000, 4000, 5000 mg/kg bw); Toxic, morality was observed at a dose of 2500 and 3000 mg/kg (P. Das et al., 2010)	Methanolic extract of leaves (72.96%), flowers (52.45%), roots (48.59%) and stems (44.42%) exhibited potent DPPH scavenging activity, where IC_{50} values of methanol extract of leaves, flowers, roots and stems were 0.803, 0.972, 0.989 and	NE

Table 3 (*continued*)

Plant species	Wound healing studies		Toxicological studies		Antioxidant activities	Tyrosinase inhibitory activities
	Plant part; Application; Extract; Animal (Weight)	**Animal Model; Reference control; Effective treatment [Source for columns 2 & 3]**	**Plant part; Extract; Animal (Weight)**	**Animal model (Dose); Toxicity status [Source for columns 4 & 5]**		
					1.358 mg/ml, respectively (Basma et al., 2011).	
	Whole plant; Topical application; 200, 400 and 600 mg/kg, bw total flavonoid fraction from methanolic extract; Male Wistar rats (175 g)	EWM, IWM, DSW; DXM (0.34, i.m), PVI; 400 and 600 mg/kg methanolic extract (Bigoniya et al., 2013)				
Euphorbia thymifolia L.	NE	NE	Whole Plant; Alcohol, chloroform, and aqueous; Albino mice (25–30 g)	AOTS (50 to 2000 mg/kg bw); NT/NM up to 2000 mg/kg bw (Mamatha et al., 2014)	Methanol, chloroform, ethyacetate, n-butanol and water fractions and pure compounds (3-O-galloyl-4,6-(5)-HHDP-D-glucose, rugosin B and 1,3,4,6-tetra-O-galloyl-K-beta-D-glucose) possessed antioxidant activities (Lin et al., 2002).	NE
Ficus benghalensis L.	Bark; Topical application; 10% and oral application: 200 mg/kg/day ethanolic and aqueous extracts; Female Wistar albino rats (200–220 g)	EWM, IWM; NA; Both Ethanolic and aqueous extracts (Garg and Paliwal, 2011)	Bark; Ethanol and aqueous; Female Albino Wistar rats (200–220 g)	AOTS (5, 50, 300 and 2000 mg/kg bw); NT/NM up to 2000 mg/kg bw (Garg and Paliwal, 2011)	Aqueous extract of stem bark showed dose dependent antioxidant activity in microsomal lipid peroxidation inhibition assay with IC_{50} value of 80.24 μg/ml (Satish et al., 2013).	NE
Ficus racemosa L.	Roots; Topical application; aqueous and ethanolic extracts; Wistar albino rats of either sex (180–200 g)	EWM, IWM; PVI; Aqueous extract (Murti and Kumar, 2012)	Bark; Methanolic; Female Wistar rats (150–180 g)	AOTS (2000 mg/kg bw); NT/NM (Choudhury and Jadhav, 2013)	IC_{50} values of the root bark and heartwood in DPPH radical scavenging activity assay were 5.80 μg/ml and 4.49 μg/ml respectively (Jain et al., 2013).	Ethanolic extract of wood at 200 μg/ml concentration showed 56.41% inhibition in Tyrosinase inhibitory activity using DOPA chrome method (Meechai et al., 2010).
Ficus religiosa L.	Leaves; Topical application; 5% and 10% Hydro alcoholic extract; Wistar albino rats of either sex (150–250 g)	EWM, IWM; 5% (w/w) PVI; 10% Hydro alcoholic extract (Roy et al., 2009)	Bark; Methanolic; Swiss albino male mice	AOTS (125, 250 and 500 mg/kg bw); NT/NM (Sreelekshmi et al., 2007)	Ethylacetate root extract scavenged DPPH radical (87.61%) at 250 μg/ml and hydrogen peroxide (70.25%) at 1000 μg/ml (Sharma and Gupta, 2007).	Mushroom tyrosinase inhibitory activity of methanolic extract of seeds showed 53.73% inhibition (Mukherjee et al., 2001)
	Leaves; Topical application; 300 mg/kg ethanolic extract; Male Wistar rats (150–200 g)	EWM, IWM, DSW; FSC; 300 mg/kg ethanolic extract (Charde et al., 2010)				
Holarrhena pubescens Wall. ex G. Don	NE	NE	Seed; Ethanolic; Female albino Wistar rats	AOTS (2000 mg/kg bw); NT/NM (Saha and Subrahmanyam, 2013)	Ethyl acetate fraction of seed showed IC_{50} values of 3.38, 15.6, 16.5 and 30.6 μg/ml for the hydroxyl radical scavenging, hydrogen peroxide scavenging, nitric oxide scavenging and inhibition in lipid peroxidation assays respectively (Ali et al., 2011).	NE
Holoptelea integrifolia Planch.	Leaves and stem bark; Topical application; 5% (w/w) methanolic extract; Wistar rats (160–180 g)	EWM, IWM; 0.2% (w/w) NFZ; Methanolic extract (Reddy et al., 2008)	Leaves; Petroleum ether and methanolic; Albino mice of either sex (20–25 g)	AOTS (2000 mg/kg bw); NT/NM (Sutar et al., 2014)	IC_{50} values of methanolic extract of leaves and stem bark in DPPH free radical scavenging activity using HPLC method was 50.36 and 37.66 μg/well respectively (Reddy et al., 2008).	NE
Hyptis suaveolens (L.) Poit.	Leaves; Topical and oral application; 500 mg/kg petroleum ether, alcoholic and aqueous extracts; Wistar albino rats of either sex (1500–200 g) and Swiss albino mice of either sex (18–22 g)	EWM, IWM, DSW; NA; Petroleum ether extract (Shenoy et al., 2009b)	Leaves; Petroleum ether, solvent ether, chloroform, alcohol, chloroform and water; Swiss albino mice of either sex (18–22 g)	AOTS (5000 mg/kg bw); NT/NM, LD_{50} was found to be more than 5000 mg/kg bw (Shenoy et al., 2009a)	Antioxidant potential of essential oil determined by the DPPH method expressed as IC_{50} was 3.72 mg/ml and TEAC value determined by ABTS assay was 65.02 μg/mg (Nantitanon et al., 2007).	NE
						NE

Ipomoea carnea Jacq.	Flowers; Topical and oral application; 200 mg/kg/day bw Flavonoid compounds; Male Wistar rats (150–200 g)	EWM, IWM; ST; NA (Ambiga et al., 2007)	Leaves; Aqueous; Wistar albino rats	AOTS (5, 50, 300, 500 and 2000 mg/kg bw); Dose at 2000 mg/kg bw showed the toxic symptoms (Khalid et al., 2011)	n-butanol fraction showed 91.11% inhibition of DPPH free radical scavenging activity with IC_{50} value of 74.65 μg/ml, whereas Ethyl acetate soluble fraction showed FRAP value and lipid peroxidation inhibition value of 511.99 μg of trolox equivalents and 61.87%, respectively (Abbasi et al., 2010b).	
Lannea coromandelica (Houtt.) Merr.	Bark; Topical application; 10% (w/w) ethanolic and acetone extracts; Male Wistar rats (150–200 g)	EWM, IWM; 1% FSC; Both (Sathish et al., 2010)	Bark; Methanolic; Mice	AOTS (100 to 1000 mg/kg bw); NT/NM up to 1000 mg/kg bw (Majumder et al., 2013)	Methanolic extract of bark showed antioxidant activity with IC_{50} values of 12.32 and 34.72 μg/ml for DPPH and total ROS scavenging methods respectively (Alam et al., 2012).	NE
Lantana camara L.	Leaf; Topical application; 100 mg/kg/day bw aqueous extract; Sprague Dawley rats (200–220 g)	EWM, IWM; NA; Both (Nayak et al., 2009)	Leaves; Methanolic; Adult mice	AOTS (2 g/kg bw); NT/NM (Pour et al., 2011)	Aqueous extract of leaves exhibited antioxidant activity in DPPH radical scavenging assay (IC_{50}=42.66 μg/ml) and metal chelating activity assay (IC_{50}=1036.4 μg/ml) (Kalita et al., 2012).	NE
	Leaf; Topical application; 5% and 10% ethanolic extract; Wistar albino rats (200–250 g)	IWM; NA; 10% ethanolic extract (Abdulla et al., 2009)				
Lawsonia inermis L.	Leaves; Oral and topical application; Petroleum ether, Chloroform, Ethanol and aqueous extracts; Wistar rats of either sex (150–200 g)	EWM, IWM; NA; Ethanolic extract (Sakarkar et al., 2004)	Leaves; Ethanolic; Wistar albino rats of either sexes (200–250 g)	AOTS (100, 500, 1000 and 2000 mg/kg bw), SATS (200, 500 and 1000 mg/kg/day bw); Lethal dose of this plant is 2000 mg/kg bw and doses above 1000 mg/kg bw are toxic (Kaur et al., 2014)	Aqueous (IC_{50}=32.27 μg/ml), methanolic (IC_{50}=32.87 μg/ml), chloroform (IC_{50}=99.92 μg/ml) and hexane (IC_{50}=286.91 μg/ml) extracts of whole plant showed DPPH radical scavenging activity, aqueous (IC_{50}=12.57 in μg), methanolic (IC_{50}=12.59 in μg) and chloroform (IC_{50}=41.42 in μg) extracts of whole plant showed activity in ABTS assay, aqueous (IC_{50}=313.93 in μg), methanolic (IC_{50}=430.80 in μg) and chloroform (IC_{50}=1815.67 in μg) extracts of whole plants showed activity in FRAP assay (Guha et al., 2011).	More than 50% reduction in tyrosinase activity was achieved by a methanol extract at a concentration of 1140 mg/L (Gholamhoseinian et al., 2009).
Leonotis nepetifolia (L.) R.Br.	Leaves; Topical application; 1 and 2 g ethanolic extracts; Wistar albino rats (150–180 g)	EWM; 2% (w/w) SOF; Ethanolic extract (Nithya et al., 2011)	Stem bark; Methanolic; Swiss albino mice (18–30 g) of either sex	AOTS (10, 100, 1000, 1600, 2900 and 5000 mg/kg bw): NT/NM, LD_{50} was found to be 3807.9 mg/kg bw (Ayanwuyi et al., 2009)	DPPH free radical scavenging assay of methanol extract of leaves showed 60.57% inhibition (Veerabadran et al., 2013).	NE
Linum usitatissimum L.	Seed oil; Topical application; 0.75 and 1.5% in Eucerin-vaselin ointment; Male Wistar rats (190–210 g)	EWM; NA; Both (Farahpour et al., 2011)	Fixed seed oil; direct; Swiss albino mice of either sex	AOTS (20 ml/kg bw), SATS (3.0 ml/kg bw); NT/NM (Kaithwas et al., 2011)	100% methanol, 80% methanol, 100% ethanol and 80% ethanol extract of seed showed 83.6%, 81.3%, 42.2% and 87.5% scavenging in DPPH assay (Anwar and Przybylski, 2012).	NE
Litsea glutinosa (Lour.) C.B. Rob.	Whole plant; Topical application; 3% and 5% (w/w) ethanolic extract; Wistar rats of either sex (100–175 g)	EWM, IWM; 0.2% (w/w) NFZ; Both (Devi and Meera, 2010)	Whole plant; Aqueous; Wistar rats (100–175 g) of either sex	AOTS (2000 mg/kg bw); NT/NM (Devi and Meera, 2010)	Antioxidant activities of methanolic stem and leaf extracts in DPPH assay were recorded as 23.02% and 31.42% respectively (Kshirsagar and Upadhyay, 2009).	NE
Mallotus philippensis (Lam.) Mull. Arg.	NA	NA	Leaves; Methanolic; Female mice	AOTS (2000 mg/kg bw); NT/NM (Ramakrishna et al., 2011)	Methanolic extracts of leaf showed 91.33% inhibition in DPPH reduction assay (Ghimire et al., 2011). Total antioxidant activity (TAA) of bark extract was 5.27 mmol Trolox equivalents/g, whereas TAA of other extracts ranged from 0.05 to 1.79 mmol Trolox equivalents/g extract (Arfan et al., 2007).	NE

Table 3 (*continued*)

Plant species	Wound healing studies		Toxicological studies		Antioxidant activities	Tyrosinase inhibitory activities
	Plant part; Application; Extract; Animal (Weight)	**Animal Model; Reference control; Effective treatment [Source for columns 2 & 3]**	**Plant part; Extract; Animal (Weight)**	**Animal model (Dose); Toxicity status [Source for columns 4 & 5]**		
Martynia annua L.	Leaves; Topical application; 7.1% (w/w) ethanolic extract; Wistar albino rats of either sex (150–200 g):	EWM, IWM; 5% (w/w) PVI; Ethanolic extract (Lodhi and Singhi, 2011)	Leaves; Methanolic; Wistar albino rats (150–200 g)	AOTS (2000 mg/kg bw); NT/NM (Babu et al., 2010)	DPPH scavenging of n-butanol soluble fraction of stem and leaves were 83.62% and 82.88% respectively at concentration of 250 μg/ml. n-butanol soluble fraction of stem exhibited highest TAA (0.187) and highest FRAP value of 149.00 mg/TE (Aziz-ur-rehman et al., 2012). Methanol extract of leaves showed antioxidant properties in RP, DPPH radical scavenging activity, nitric oxide scavenging activity, H2O2 radical scavenging activity, superoxide radical scavenging assay, hydroxyl radical scavenging activity and total antioxidant method (Nagda et al., 2009).	NE
Millettia extensa (Benth.) Baker	NE	NE	NE	NE	NE	NE
Mirabilis jalapa L.	NE	NE	Flowers; Hydroethanolic; Female rat	AOTS (2000 mg/kg bw); NT/NM (Augustine et al., 2013)	Crude methanol extract of the bark showed IC_{50} value of 598.02 μg/ml in DPPH assay (Rumzhum et al., 2008). EC_{50} values for ABTS free radical scavenging activity were 1249 μg/ml and 974 μg/ml for methanolic root and aerial extracts respectively, EC_{50} values for DPPH radical scavenging activity were 1679 μg/ml and 3723 μg/ml for methanolic root and aerial extracts respectively (Zachariah et al., 2011).	NE
Mitragyna parvifolia (Roxb.) Korth.	NE	NE	Leaves; Ethanolic; Swiss albino mice (25–30 g)	AOTS (5, 100, 300 and 1500 mg/kg bw); NT/NM (Kaushik et al., 2009a)	DPPH activity of ethanolic leaf extract was 87.6% at a concentration of 500 μg/ml, whereas percentage inhibition of superoxide generation at 500 μg/ml concentration was 65.0% in superoxide radical scavenging assay (Kaushik et al., 2009c).	NE
Momordica dioica Roxb. ex Willd.	NE	NE	Fruits; Aqueous; Wistar rats (150–200 g)	AOTS (5, 10 and 15 times of effective dose (ED) *i.e.*, 200 mg/kg bw; NT/NM even with 15 times of ED (R. Singh et al., 2011)	Ethanolic extract of root scavenge the super oxide generated by ascorbic system at the dose of 12.5 μg/ml, whereas at concentration of 400 μg/ml DPPH radical scavenging activity was recorded as 77.30% (Shreedhara and Vaidya, 2006). *In vivo* antioxidant and free radical scavenging activities were positive for both ethanolic and aqueous extracts of leaves (Jain et al., 2008). Hydroethanolic extract of leaves at 200 and 400 mg/kg concentration	Extracts of leaf had potent inhibitory effects on *L*-DOPA oxidase activity of tyrosinase enzyme with 74% inhibition (Nagarani et al., 2014) NE

Mucuna pruriens (L.) DC.	Seeds; Topical application; 1% and 2% methanolic extract; Swiss albino mice (20–25 g):	EWM, IWM; FRA; 2% methanolic extract (Gunde et al., 2013)	Seeds; Methanol; Albino mice of both sexes	AOTS (150, 300, 500, 1000, 2000, 3000 and 4000 mg/kg bw); NT/NM (Manalisha and Chandra, 2012)	significantly reversed the diminution in the level of *in vivo* antioxidants in rats (Obogwu et al., 2014). *In vitro* study of seed extract possesses dose dependent protection against superoxide generation, hydroxyl radical production and $FeSO_4$ induced lipid peroxidation in normal albino rats (100-150 g bw) of Charles Foster strain (Tripathi and Upadhyay, 2001).	
Nicotiana plumbaginifolia Viv.	NE	NE	NE	NE	NE	NE
Oroxylum indicum (L.) Kurz	Root; Topical application; 1% and 2.5% methanolic extract; Albino mice (NA)	BWM; SSD, CHG; Methanolic extract (H. Singh et al., 2011)	Roots; Ethanolic; Wistar male albino rats (150–200 g)	AOTS (5000 mg/kg bw); NT/NM (Tamboli et al., 2011)	IC_{50} values in DPPH radical scavenging assay of root extract, root bark extract, stem extract, stem extract, leaf extract and fruit extract was recorded as 158.23, 112.21, 189.36, 149.59, 106.4 and 159.46 μg/ml respectively, Nitric oxide radical scavenging assay of root extract, root bark extract, stem extract, stem extract, leaf extract and fruit extract was recorded as 102.56, 89.36, 88.15, 139.90, 72.05 and 182.25 μg/ml respectively, Superoxide radical scavenging assay of root extract, root bark extract, stem extract, stem extract, leaf extract and fruit extract was recorded as 455.36, 154.96, 681.22, 137.30, 170.87 and 399.86 μg/ml respectively, Hydroxy radical scavenging assay of root extract, root bark extract, stem extract, stem extract, leaf extract and fruit extract was recorded as 179.35, 47.01, 309.27, 33.30, 46.52 and 76.39 μg/ml respectively (Mishra et al., 2010).	NE
Persicaria barbata (L.) H.Hara	NE	NE	Leaves; Alcoholic; Wister albino rats	AOTS (5, 50, 300 and 2000 mg/kg bw); NT/NM safe up to dose of 2000 mg/kg bw (Sheela et al., 2011)	NE	NE
Phyllanthus amarus Schumach. and Thonn.	Whole plant; Oral application; 200 mg/kg alcoholic extract; Male Wistar albino rats (150–200 g)	EWM, IWM, DSW; 0.17 mg/kg DXM; Alcoholic extract (Devi et al., 2005)	Leaves; Aqueous; Female rats (150–200 g)	AOTS (2000 and 5000 mg/kg bw); NT/NM safe up to dose of 5000 mg/kg bw (Asare et al., 2011)	Aqueous (IC_{50}=52.14 μg/ml), methanolic (IC_{50}=63.50 μg/ml), chloroform (IC_{50}=367.28 μg/ml) and hexane (IC_{50}=454.34 μg/ml) extracts of whole plant showed DPPH radical scavenging activity, aqueous (IC_{50}=12.58 in μg) and methanolic (IC_{50}=16.56 in μg) extracts of whole plants showed activity in ABTS assay, aqueous (IC_{50}=392.37 in μg) and methanolic (IC_{50}=448.81 in μg) extracts of whole plants showed activity in FRAP assay (Guha et al., 2011).	NE
Pongamia pinnata (L.) Pierre	Leaves; Topical application; 200 mg/kg methanolic extract; Wistar albino rats of either sex (180–230 g)	EWM, IWM; PIO; Methanolic extract (Prasad et al., 2011)	Seed; Crude extracts; Wistar female albino rats (100–120 g)	AOTS (2000 mg/kg bw); NT/NM (Aneela et al., 2011)	Chloroform and butanol extracts of seeds at conc. of 500 μg significantly inhibited the generation of hydroxyl radical and superoxide anions as well as the reaction of lipid peroxidation in rat liver microsomes induced by Fe^{+2} (Bhatia et al., 2008). *In-vitro* antioxidant activity of cycloart–23-ene–3β, 25-diol isolated from stem	NE

Table 3 (*continued*)

Plant species	Wound healing studies		Toxicological studies		Antioxidant activities	Tyrosinase inhibitory activities
	Plant part; Application; Extract; Animal (Weight)	**Animal Model; Reference control; Effective treatment [Source for columns 2 & 3]**	**Plant part; Extract; Animal (Weight)**	**Animal model (Dose); Toxicity status [Source for columns 4 & 5]**		
					bark showed dose dependent% reduction against DPPH radical, reducing power, superoxide anion radical scavenging, hydroxyl radical scavenging, metal chelating, hydrogen peroxide scavenging and nitric oxide radical scavenging by B2 and β-tocopherol (Badole et al., 2011).	
Premna mollissima Roth	NE	NE	Leaves; Methanolic; Albino mice of either sex	AOTS (100, 500, 1000, 3000 and 5000 mg/kg bw); NT/NM (Mahire et al., 2009)	NE	NE
Ranunculus sceleratus L.	NE	NE	NE	NE	NE	NE
Rauvolfia serpentina (L.) Benth. ex Kurz	NE	NE	Root; Methanolic; Male Wistar albino mice (20–30 g)	AOTS (10, 30, 60, 100, 150, 200 and 250 mg/kg bw); Doses at 150, 200 and 250 mg/kg bw showed acute toxicity, therefore, LD_{50} was determined as 141.25 mg/kg bw (Azmi and Qureshi, 2012)	NE	NE
Ricinus communis L.	NE	NE	Root; Aqueous and methanolic; Wistar albino rats	AOTS (2000 mg/kg bw), SATS (1000 mg/kg bw); NT/NM (Ilavarasan et al., 2011)	IC_{50} values for the leaves extracts ranged from 0.65 to 2.39 μg/ml in DPPH radical scavenging assay (Wafa et al., 2014). Aqueous methanol extract of dry leaves had IC_{50} value of 2.70 μg/ml in DPPH radical scavenging assay (P.P. Singh et al., 2009).	NE
Scoparia dulcis L.	Roots; Topical application; 5 and 10% (w/w) ethanolic extract; Wistar albino rats of either sex (180–200 g)	EWM, IWM, DSW; 0.2% (w/w) NFZ; 10% Ethanolic extract (Murti et al., 2011)	Whole plant; Methanolic; Mice	AOTS (10, 100, 1000, 1600, 2900 and 5000 mg/kg bw); NT/NM, LD_{50} 3807 mg/kg bw (Abdulsalaam et al., 2013)	Freeze dried aqueous extract at 0.01, 0.1 and 1.0 mg/ml concentration showed antioxidant index of 26.92, 34.95 and 48.26, respectively and EC_{50} value was 1.08 mg/ml (Ratnasooriya et al., 2005).	NE
Semecarpus anacardium L.f.	NE	NE	Nuts; *Serankottai nei*-a Siddha preparation by milk extracts of nuts; Wistar strain male albino rats (80–100 g)	AOTS (75–2000 mg/kg bw), SATS (50, 100, 250 and 500 mg/kg bw); NT/NM, dose of 500 mg/kg bw in SATS showed moderate changes (Vijayalakshmi et al., 2000)	DPPH radical scavenger activity of hexane, chloroform, ethyl acetate and methanol extract of stem bark was reported as 103.69, 82.45, 44.03 and 60.23 μg/ml respectively, Lipid peroxidation activity of hexane, chloroform, ethyl acetate and methanol extract of stem bark was reported as 205.08, 187.43, 102.34 and 165.21 μg/ml respectively, Nitric oxide radical scavenger activity of hexane, chloroform, ethyl acetate and methanol extract of stem bark was reported as 176.33, 132.43, 80.75 and 119.23 μg/ml respectively, Superoxide radical scavenger activity of hexane, chloroform, ethyl acetate and methanol extract of stem bark was reported as 89.91, 73.23, 68.55 and 78.21 μg/ml respectively (Sahoo et al., 2008).	NE

Senna tora (L.) Roxb.	Leaves; Topical application; 5% (w/w) ethanolic extract; Wistar albino rats (150–180 g)	EWM; 0.2% (w/w) NFZ; Ethanolic extract (Jayasutha and Nithila, 2011)	Leaves; Ethanolic; Swiss albino mice of both sexes	AOTS (100, 1000, 10000 mg/kg bw), SATS (500, 1000 mg/kg/day bw); NT/NM (Ambali et al., 2005)	EC_{50} values of ethyl acetate, n-butanol and water fraction was recorded as 70.1, 578.0 and 770.0 μg/ml respectively in DPPH assay, whereas ferrous ions chelating activity of ethyl acetate, n-butanol and water fraction was recorded as 70.57%, 13.60% and 30.40% at 0.5 mg/ml concentration, respectively (Zhenbao et al., 2007).	NE
Sesamum indicum L.	NE	NE	Seed oil; direct; Swiss albino mice (25–30 g)	AOTS (oil oral doses of 0.5, 1, 1.5, 2 and 3 g/kg bw); NT/NM (Monteiro et al., 2014)	Sesamol from seed showed IC_{50} value of 5.44 μg/ml in DPPH free radical assay (C. M. Kumar et al., 2011)	Sesamol from seed showed tyrosinase inhibition with IC_{50} value of 3.2 μM in mushroom tyrosinase assay (C.M. Kumar et al., 2011).
Shorea robusta Gaertn.	Resin; Topical application; 10 and 30% ethanolic extract; Wistar albino rats (150–250 g), Swiss mice (18–20 g)	EWM, IWM; 1% (w/w) FRA; Both (Wani et al., 2012a)	Leaves; Aqueous and methanol; Swiss albino mice (18–20 g) and male wistar rats (150–180 g)	AOTS (0–2500 mg/kg orally (P.O.) and 0–1000 mg/kg (i.p.)); NT/NM with LD_{50} of orally fed methanolic and aqueous extract of 2.4 g/kg and 2.7 g/kg bw, while it was 1.2 g/kg and 1.4 g/kg i.p. respectively (Chattopadhyay et al., 2012)	NE	NE
Sida cordata (Burm. F.) Borss. Waalk.	NE	NE	NE	NE	Leaf extract reduced the lipid peroxidation in the liver tissue and restored activities of defense antioxidant enzymes superoxide dismutase (SOD), lipid peroxidation, catalase (CAT), reduced glutathione (GSH) towards normal levels in Wister albino rats (Mistry et al., 2013).	NE
Sida rhombifolia L.	NE	NE	Root; Aqueous; Male and female Sprague-Dawley rats (130–190 g)	AOTS (5,000 mg/kg bw), SATS (300, 600 and 1200 mg/ml bw); NT/NM (Sireeratawong et al., 2008)	Ethanol extracts of root, leaves, whole plant and stem showed 50% inhibitory concentrations of 546.1, 852.8, 983.8, and 1,222.5 μg/ml, respectively in DPPH assay (Dhalwal et al., 2007).	NE
Solanum incanum L.	NE	NE	Fruit; Ethanolic; Female Swiss albino mice (25–30 g)	AOTS (100, 250, 500, 750, 1000 and 2000 mg/kg bw); NT/NM (Indhumathi et al., 2014)	NE	NE
Terminalia arjuna (Roxb. ex DC.) Wight & Arn.	Bark; Topical application; hydroalcoholic extract; Rats (NA)	EWM, IWM; NA; NA (Chaudhari and Menqi, 2006)	Leaves; Methanolic; Adult male Swiss albino mice (18–22 g)	AOTS (900 mg/kg bw), SATS (200 mg/kg bw for 28 days); NT/NM with LD_{50} 900 mg/kg bw (Biswas et al., 2011a)	Reducing power of bark extracts at 10 mg/ml concentration were 1.340, 1.600 and 1.740 for 80% ethanol, 80% methanol and 80% acetone extracts respectively (Sultana et al., 2007).	NE
Tridax procumbens (L.) L.	Whole plant; Topical application; aqueous extract, butanol fraction and petroleum ether fraction; Albino rats (NA)	EWM, IWM; NA; NA (Udupa et al., 1995)	Leaves; Ethyl acetate; Swiss albino mice of both sexes each (20–30 g) and albino rats (50–80 g)	AOTS (10, 100, 1000, 1600, 2900 and 5000 mg/kg bw), Short term toxicity study (50, 100, 200, 400 and 800 mg/kg/day bw for 14 days); LD_{50} of the extract was 2100 mg/kg bw (Abubakar et al., 2012)	Ethyl acetate and methanol extract of aerial parts showed IC_{50} values of 45.95 and 35.62 μg/ml, respectively in DPPH assay, whereas IC_{50} values of 24.47 and 18.17 μg/ml were reported for ethyl acetate and methanol extracts of aerial parts in ABTS assay (Jachak et al., 2011).	NE
Typha domingensis Pers.	NE	NE	NE	NE	Superoxide scavenging half-maximal effective concentration (EC_{50}) of fruit, female flower and male flower extracts was 3.5, 4.8, and 28.2 mg dry matter (DM)/ml, respectively, while nitric oxide scavenging EC_{50} of fruit, female flower and male flower extracts was 0.16, 0.65, and 0.95 mg DM/ml, respectively. Iron chelating EC_{50} of female flower, male flower and fruit extracts was 4.86, 6.43, and 10.88 mg DM/ml, respectively (Chai et al., 2014).	NE
	NE	NE				NE

Table 3 (*continued*)

Plant species	Wound healing studies		Toxicological studies		Antioxidant activities	Tyrosinase inhibitory activities
	Plant part; Application; Extract; Animal (Weight)	**Animal Model; Reference control; Effective treatment [Source for columns 2 & 3]**	**Plant part; Extract; Animal (Weight)**	**Animal model (Dose); Toxicity status [Source for columns 4 & 5]**		
Vallaris solanacea (Roth) Kuntze			Root bark oil; Ethanolic; Albino rats (150–200 g)	Toxicity study (3 and 5 ml/kg bw); NT/NM (Punam et al., 2012)	Ethanolic extract in qualitative test of DPPH free radical assay showed antioxidant activity (Karmakar et al., 2011).	
Vanda tessellata (Roxb.) Hook. ex G.Don.	Whole Plant; Topical application; NA; Rats(NA)	EWM; NA (Nayak et al., 2005)	Whole plant with flowers; Water and alcoholic; Swiss mice (25–35 g)	AOTS (0, 0.5, 1.0 and 2 g/kg bw), SATS (200 and 400 mg/kg bw); NT/NM (Kumar et al., 2000)	NE	NE
Verbascum thapsus L.	Flowers; Topical application; 20% chloroform methanol extract; Male rabbits (1500 g)	PIW; 20% ZNO; 20% Chloroform methanol extract (Mehdinezhad et al., 2012)	Leaves; Aqueous	Brine Shrimp and radish seed bioassays Toxic at higher doses(around 1000 mg/L) with LC_{50} of $<$ 1000 mg/L (Turker and Camper, 2002)	Aqueous extract of flower showed total antioxidant capacity of 195 μmol Trolox equivalent/g dry wt in a two-stage Trolox based assay (VanderJagt et al., 2002).	NE
Vitex negundo L.	Leaves; Topical application; 200 mg/kg/day aqueous and ethanolic extracts; Wistar rats of both sexes (150–200 g)	EWM, IWM; 5% PVI; Both extracts (Talekar et al., 2012)	Oil; direct; Wistar rats of both sexes	Acute dermal toxicity study (2000 mg/kg bw), Sub-chronic dermal toxicity study (250, 500 and 1000 mg/kg bw); NT/NM, LD_{50} value was over 2000 mg/kg bw (Chattopadhyay et al., 2014)	Aqueous (IC_{50}=80.45 μg/ml), Methanolic (IC_{50}=93.73 μg/ml), Chloroform (IC_{50}=190.58 μg/ml) and hexane (IC_{50}=913.76 μg/ml) extracts of whole plant showed scavenging activity in DPPH assay, Aqueous (IC_{50}=13.01 in μg) and Methanolic (IC_{50}=23.25 in μg) extracts of whole plants showed antioxidant activity in ABTS assay, whereas aqueous (IC_{50}=1021.38 in μg) and methanolic (IC_{50}=476.91 in μg) extracts of whole plant showed activity in FRAP assay (Guha et al., 2011).	Tyrosinase inhibition activity by (+)-lyoniresinol from roots showed inhibitory activity with IC_{50} value of 3.21 μM (Azhar-ul-Haq et al., 2006).
Wrightia arborea (Dennst.) Mabb.	Leaves; Topical application; NA; Wistar albino Rats of either sex (150–200 g)	EWM, IWM; 0.2% NFZ; NA (Devi and Divakar, 2013)	Leaves; Methanolic; Male albino rats (120–140 g)	AOTS (2000 mg/kg bw); NT/NM (Nahar et al., 2013)	Free radical scavenging activity of ethanolic bark extract has shown ability to suppress the oxidation (D.L. Kumar et al., 2011).	NE
Ziziphus nummularia (Burm. f.) Wight & Arn.	Leaves; Topical application; 20 and 30% ethanolic extracts; Wistar albino rats (200 g)	EWM; 10% (w/w) PIO; 30% ethanolic extract (Yusufoglu, 2011)	Leaves; Cyclopeptide alkaloid fraction; Wistar rats of both sexes (180–200 g) and Swiss mice (20–24 g)	AOTS (50, 200 and 300 mg/kg bw); Category-3 having LD_{50} 200 mg/kg bw, CNS depression and reduction in locomotor activity in mice treated with 200 and 300 mg/kg bw (Goyal et al., 2013)	Aqueous ethanol extract of peel (200.22 to 40.26 AEAC/100 g DW), pulp (51.30 to 28.56 AEAC/100 g DW) and seed (50.06 to 22.44 AEAC/100 g DW) showed scavenging activity in DPPH assay, whereas, aqueous ethanol extract of peel (372.49 to 3852.88 AEAC/100 g DW), pulp (982.31 to 252.43 AEAC/100 g DW) and seed (639.05 to 219.94 AEAC/100 g DW) also showed activity in FRAP assay (Zhang et al., 2010).	NE

Abbreviations: ABTS=2,2′-azino-bis(3-ethylbenzothiazoline-6-sulfonic acid) assay, AOTS=acute oral toxicity study, BWM=burn wound model, CHG=chlorhexidine gluconate, CTS=chronic toxicity study, DPPH=2,2-diphenyl-1-picrylhydrazyl assay, DSW=dead space wound model, DXM=dexamethasone, EWM=excision wound model, FRA=framycetin, FRAP=ferric reducing antioxidant powder assay, FSC=framycetine sulfate cream, IWM=incision wound model, NA=not available, NE=not evaluated, NEO=neosporin, NFZ=nitrofurazone, NT/NM=non-toxic/no mortality, PIW=punch incision wound model, PVI=povidone iodine ointment, RP=reducing power, SATS=sub acute toxicity study, SOF=soframycin, SSD=silver sulphadiazine, ST=sulphathiazole, TAC=total antioxidant capacity, ZNO=zinc oxide.

Table 4
Earlier studies showing anti-inflammatory and antimicrobial activities, and active compounds in the plants reported in the present study.

Plant species	Antiinflammatory studies		Microbiological studies		Active compound [Plant part]; Biological activity related to skin problems (DNP, 2014)
	Plant part; Extract; Animal (Weight)	Animal Model (Dose); Reference control; Activity [Source for columns 2 & 3]	Plant part tested; Solvent or extracts used: Tested against (micro-organism)	Effective extract; Most effective against; Phytoconstituents [Source for columns 4 and 5]	
Acalypha indica L.	Whole plant; Methanolic; Swiss albino mice (20-25 g) and Long Evans rats (140–160 g) of either sex	CPE (125 and 250 mg/kg bw); Reference drug, Phenylbutazone (100 mg/kg bw); AIA (Rahman et al., 2010)	Leaves; Water, ethanol and chloroform; Bacteria; *Escherichia coli, Salmonella enteritidis, Staphylococcus aureus, Bacillus subtilis* and fungi; *Candida albicans, Candida tropicalis, Microsporum canis, Aspergillus fumigatus*	Water and ethanol for gram positive bacteria, Antifungal activity in chloroform extract; NA (Somchit et al., 2010)	NE
			Whole plant; Ethyl acetate, methanol, Ethanol and diethyl ether; *Bacillus subtilis, Escherichia coli, Enterococcus feacials, Pseudomonas aeroginosa, Staphylococcus aureus, Staphylococcus epidermis, Klebsiella pneumonia, Proteus vulgaris*	Ethyl acetate; Most of the bacterial strains; Tannins, steroids, saponins, cardiac glycosides, terepens, alkaloids (Poornima and Prabakaran, 2012)	
Achyranthes aspera L.	Roots; Alcoholic; Wistar rats	CPE, CPG (50,100 and 200 mg/kg bw); NA; AIA in both models (S.V. Kumar et al., 2009)	Roots; Ethyl acetate, acetone, ethanol; *Bacillus subtilis*, *Streptococcus aureus*, *Salmonella typhimurium*, *Escherichia coli*, *Pseudomonas aeruginosa*, *Salmonella abony*	Ethanol; Most of the bacterial strains; NA (Shendkar et al., 2012)	17-Pentatriacontanol [shoot]; Antifungal agent.
	Leaves; Topical application of methanolic extract; Male Wistar rats	CPE; NA; Weak AIA (Khuda et al., 2013)			
Acorus calamus L.	Leaves; Aqueous; On human keratinocyte HaCaT cells.	PPCIN, PGNIN; NA; AIA (Kim et al., 2009)	Rhizome; Ethanol; Bacteria: *Pseudomonas sp., Bacillus sp., Staphylococcus aureus* and fungus: *Aspergillus niger, Aspergillus flavus, Trichoderma* sp.	Ethanol; *Pseudomonas* sp., *Staphylococcus aureus, Aspergillus flavus;* Aromatic compounds, ketone, alkaloid, fatty acids like palmitic acid and linoleic acid (Senthilkumar et al., 2010)	4-Acoren-3-one (multi drug resistance MDR inhibitory activity) and 2,5-Dihydroxy-1,4-benzoquinone (mild activity against gram-positive bacteria and mycobacteria); Antibacterial agents. 1-(4-Hydroxyphenyl)-2-propen-1-ol; Superoxide anion generation inhibitor. Inhibits tumor promotion by TPA JWJ26 on ICR mouse skin.
Ageratum conyzoides (L.) L.	Whole plants; Alcoholic; Swiss albino mice (25–30 g) and Wister albino rats of the both sexes (150–200 g)	CPE; Diclofenac sodium (40 mg/kg bw); NA; AIA (M.A. Rahman et al., 2012)	Leaves; methanol, ethanol, distilled water, hexane, ethyl acetate and acetone; *Staphylococcus* and *Escherichia coli*	Methanol; *Staphylococcus* and *Escherichia coli;* Alkaloids, tannins, saponins, glycoside, flavonoids, resins and anthraquinone (Onuoha et al., 2013)	NE
Albizia lebbeck (L.) Benth.	Bark; Petroleum ether, ethyl acetate and methanolic	CPE (400 mg/kg bw); NA; AIA (Saha and Ahmed, 2009)	Leaves; Petroleum ether, ethyl acetate, methanol; *Bacillus subtilis*, *Escherichia coli*, *Klebsiella pneumonia*, *Proteus vulgaris*, *Pseudomonas aeruginosa*, *Salmonella typhii*, *Staphylococcus aureus*.	Methanol; *Salmonella typhii*, ethyl acetate; *Escherichia coli;* Flavonoids, tannins, saponins (Bobby et al., 2012)	NE
			Leaves; ethyl acetate; *Escherichia coli, Staphylococcus aureus, Pseudomonas aeruginosa, Bacillus cereus*	Ethyl acetate; *Pseudomonas aeruginosa;* Alkaloids, glycoside, tannins, saponins, flavanoids, carbohydrates (Chulet et al., 2010)	
Allium cepa L.	Bulbs; Male albino rats (125–150 g)	CPE; HPE; Reference drug, Diclofenac (5 mg/kg bw); AIA (Riyaz et al., 2012)	Onion oil; 4 gram positive, 4 gram negative and 9 fungal strains	Against all the tested microorgamisms; NA (Zohri et al., 1995)	Di-2-propenyl disulfide, protein 1 [seed] and allicepin [bulb]; Antifungal agents. Protein 1 [seed]; Antibacterial agents. Antimicrobial protein 1 in seeds; Antimicrobial agent. Alliuocide G, 3-Mercapto-2-methylpentanol, *Allium* Quercetin trimer, Quercetin-protocatechuic acid heterodimer and *Allium cepa* Antimicrobial protein 1; Antioxidants.
Amaranthus spinosus L.		CPE (250, 500 and 750 mg/kg bw); Reference drug,	Leaves; hexane, ethyl acetate, dichloromethane and methanol; Grampositive: *Staphylococcus*		NE

Table 4 (*continued*)

Plant species	Antiinflammatory studies		Microbiological studies		Active compound [Plant part]; Biological activity related to skin problems (DNP, 2014)
	Plant part; Extract; Animal (Weight)	**Animal Model (Dose); Reference control; Activity [Source for columns 2 & 3]**	**Plant part tested; Solvent or extracts used: Tested against (micro-organism)**	**Effective extract; Most effective against; Phytoconstituents [Source for columns 4 and 5]**	
	Leaves; Petroleum ether and ethanolic; Male or female albino rats (140–160 g)	Ibuprofen (10 mg/kg bw); AIA (Baral et al., 2010)	*aureus* and *Bacillus* spp, gram-negative *Escherichia coli, Salmonella typhi, Pseudomonas aeruginosae, Proteus mirabillis* and *Klebsiella pneumoniae* and a pathogenic fungus *Candida albicans*	*Salmonella typhi;* flavonoids, steroids, terpenoids, saponins and cardiac glycosides (Maiyo et al., 2010)	
Anisomeles indica (L.) Kuntze	Leaves and stem; Freeze-dried decoction; Rats	CPE, FoPE, APE (125, 250 and 500 mg/kg bw); NA; AIA (Dharmasiri et al., 2002)	Leaves; aqueous, methanolic, ethanolic, Chloroform and ethyl Acetate; *Escherichia coli, Staphylococcus aureus, Proteus vulgaris, Pseudomonas aeruginosa* and *Klebsiella pneumonia*	Chloroform; *Pseudomonas aeruginosa;* NA (Dixit, 2013)	3,7,11,15(17)-Cembratetraene-16,2:19,6-diolide; Induces cell cycle arrest and apoptosis in human oral squamous cell carcinoma Ca9-22 cells.
Annona squamosa L.	Bark; Caryophyllene oxide isolated from an unsaponified petroleum ether extract; Wistar albino rats of either sex	Caryophyllene oxide (12.5 and 25 mg/kg bw); NA; AIA (Chavan et al., 2010)	Seeds, methanol, petroleum ether, and chloroform; Gram-positive (*Bacillus subtilis, Staphylococcus aureus*) and Gram-negative (*Escherichia coli, Pseudomonas aeruginosa* and *Klebsiella pneumoniae*)	Methanol, Chloroform: All the test organisms; NA (Aher et al., 2012)	3-(14,17:18,21-Diepoxydotriacontyl)-5-methyl-2(5 *H*)-furanone; Shows antitumor activity *in vitro.* 3-(12,15:16,19-Diepoxydotriacontyl)-5-methyl-2(5 *H*)-furanone; Cytotoxic agent showing activity against human prostate tumour cells. 3-(14,17:18,21-Diepoxydotriacontyl)-5-methyl-2(5 *H*)-furanone and Parviflorin, Bullatacinone, Mosinone A, Squamostanin A, Annosquatin I, Rollicosin and 2-(18,21-Epoxydotriacontyl)-2,5-dihydro-5-methyl-2 (5 H)-furanone; Cytotoxic agent.
Argemone mexicana L.	Leaves; Lyophilized aqueous extract; Male and female white mice (rain NMRI) (25–30 g)	CPE (250 and 500 mg/kg bw); Reference drug, Paracetamol (100 mg/kg bw); Significant AIA (Sourabie et al., 2012)	Leaves, seeds; Crude methanol, aqueous, n hexane, chloroform, methanol; *Staphylococcus aureus*, *Bacillus subtilis*, *Escherichia coli*, *Pseudomonas aeruginosa*, *Enterococcus* sp., *Salmonella typhi*.	Methanol, Chloroform: All the test organisms; Alkaloids, amino acids, phenolics, fatty acids (Priya and Rao, 2012)	Sanguinarine; Toxic to animals, potent cytotoxic, antifungal, antibacterial and antimicrobial agent.
			Leaf, Stem; Acetone, ethyl acetate, petroleum ether; *Escherichia coli, Shigella* sp., *Staphylococcus* sp., *Salmonella* sp.	Petroleum ether; *Staphylococcus* sp., *Escherichia coli;* NA (Rahman et al., 2011)	Isorhamnetin 3,7-diglycosides; Antioxidant.
Azadirachta indica A. Juss.	Roots; Alcoholic; Wistar albino rats of either sex	CPE, CPG (200, 400and 800 mg/kg bw); Reference drug, Aspirin (100 mg/kg bw); AIA (Patil et al., 2012)	Leaves; Aqueous; *Escherichia coli* and *Salmonella* sp.	Aqueous ; Against all the tested organisms; Alkaloids, steroids, tannin (Susmitha et al., 2013)	10-Undecyn-1-ol [leaf]; Antifungal agent.
			Leaves; Methanol; *Escherichia coli, Pseudomonas aeruginosa, Klebsiella pneumonia, Streptococcus pyrogens, Staphylococcus aureus*	Methanol; *Pseudomonas aeruginosa;* Reducing sugar, glycosides, tannins, triterpenes (Vasantharaj et al., 2013)	Nimbolide, marnoodin, α-Nimolactone, β-nimolactone and tetrahydro-3,4-furandiol; Antibacterial agents. Nimbolide; Cytotoxic towards human tumor cells. 7-Hydroxy-1-meliacene-3,15-dione; Shows antitumour activity.
Bambusa bambos (L.) Voss	Leaves; Methanolic; Albino rats	CPE, IPE; NA; Significant AIA (Muniappan and Sundararaj, 2003)	Leaves; hexane, ethyl acetate, ethanol and hydroalcohol; *Escherichia coli, Bacillus subtilis, Staphylococcus aureus, Klebsiella pneumonia Pseudomonas aeruginosa*	Hydroalcohol as well as ethanol; *Escherichia coli;* NA (Sandhiya et al., 2013)	NE
Bauhinia variegata L.	Bark; Methanolic and aqueous; Albino rats (150–200 g)	CPE, DPE (200 and 250 mg/kg bw); NA; AIA (Bairagi et al., 2012)	Stem bark; Methanol, aqueous, ethanol; *Bacillus cereus*, *Staphylococcus aureus*, *Klebsiella pneumonia*, *Escherichia coli*, *Pseudomonas pseudoalcaligense*, *Bacillus subtilis*, *Pseudomonas*	Methanol, ethanol; Gram positive bacteria; Quercitroside, isoquercitroside, rutoside, myricetol glycoside, kaempferol glycoside (Sahu and Gupta, 2012)	3′,4′,5,7-Tetrahydroxy-3-methoxyflavone; Anti-inflammatory agent.

			aeruginosa, *Salmonella typhi*, *Shigella dysenteriae*, *Vibrio cholera*		
Boerhavia diffusa L.	Leaves; Ethanolic; Mice	CPE, SPE, HPE, DPE (400 mg/kg bw); NA; AIA (Mahesh et al., 2012)	Leaves; Ethanol, ethylacetate, diethyl ether, methanol, chloroform, aqueous; *Escherichia coli*, *Pseudomonas aeruginosa*, *Salmonella typhi*, *Klebsiella pneumoniae*, *Proteus vulgaris*, *Serratia marcescens*, *Shigella flexneri*, *Vibrio cholerae*, *Staphylococcus aureus*, *Bacillus subtilis*, *Streptococcus faecalis*, *Micrococcus luteus*	Ethanol, chloroform, aqueous; More activity towards human pathogenic organisms except *Vibrio cholerae;* Quinones, saponinis, triterpenoids, flavonoids, alkaloids, steroids, tannins, furanoids, phenols (Umamaheswari et al., 2010)	NE
Brassica juncea (L.) Czern.	Seeds; Petroleum ether and ethanolic; Male Wistar albino rats (150–200 g)	CPE (250 and 500 mg/kg bw); Reference drug, Ibuprofen (10 mg/kg bw); AIA (Sindhoor et al., 2012)	Seed meal; Crude extract and purified phenolic fractions; *Staphylococcus aureus, Listeria monocytogenes, Lactobacillus plantarum, Bacillus subtilis, Eschrichia coli, Pseudomonas fluorescens*	Crude extract and purified phenolic fraction; *Staphylococcus aureus, Listeria monocytogenes* (Engels et al., 2012)	Cyclobrassinin sulfoxide and brassilexin [leaf]; Phytoalexin. Isorhamnetin 3,7-diglycosides; Antioxidant.
Buchanania cochinchinensis (Lour.) M. R.Almeida	Kernels; Methanolic; Wistar rats (150–200 g)	CPE (100 and 200 mg/kg bw); Reference drug, Indomethacin (10 mg/kg bw); AIA (Warokar et al., 2010)	Bark; Methanol; Bacteria (*Bacillus cereus*, *Escherichia coli*, *Proteus vulgaris*, *Pseudomonas aeruginosa*, *Bacillus subtilis*, *Salmonella* sp., *Staphylococcus aureus*) and fungal species (*Aspergillus niger*, *penicillium* sp. and *Trichoderma viride*)	Methanol; *Escherichia coli, Staphylococcus aureus;* saponins, flavanoids, steroids, cardiac glycosides, alkaloids, tannins and phenolics (Venkata et al., 2012)	NE
Butea monosperma (Lam.) Taub.	Flowers; Ethanolic; Male Wistar albino rats of either sex (150–200 g)	CPE; Reference drug, Diclofenac gel (0.2 g 1%); AIA (Sapkale et al., 2013)	Leaves; Ethanol, aqueous; *Staphylococcus aureus*, *Escherichia coli*	Ethanol; both; Alkaloids, carbohydrates, tannins, flavonoids, phenolic compounds, starch (Ramanjaneyulu et al., 2011)	5,7-Dihydroxy-3,4′,6-trimethoxyflavone [flower]; Antifungal agent.
Caesulia axillaris Roxb.	NE	NE	Essential oil; *Trichophyton tubrum* and *Microsporum gypseum*	Essential oil; *Trichophyton tubrum* and *Microsporum gypseum* (Kishore et al., 1993)	NE
Callicarpa macrophylla Vahl	Leaves; Ethanolic and aqueous; Male and female albino rats (120–150 g)	CPE (200 and 400 mg/kg bw); Reference drug, Diclofenac sodium (20 mg/kg bw); AIA (Yadav et al., 2011)	Stem; Ethanol, aqueous; Gram +ve *Streptococcus pyogens, Bacillus,Micrococcus luteus, Staphylococcus epidermidis, Clostridium sporogens, Streptococcus faecalis, Staphylococcus aureus, Bacillus subtilis* and Gram –ve *Agrobacterium tumifaciens, Klebsiella pneumonia, Salmonella typhimurium, Pseudomonas aeruginosa, Serratia marcesens, Enterobacteria aerogens, Proteus vulgaris, Escherichia coli*	Ethanol; *Bacillus subtilis;* NA (V. Yadav et al., 2012)	NE
Calotropis procera (Aiton) Dryand.	Roots; Ether, benzene, chloroform, methanol and aqueous; Wistar rats of either sex (125-175 g)	CPE (200 mg/kg bw); Reference drug, Diclofenac sodium, (25 mg/kg bw); AIA (Babu and Karki, 2011)	Flowers; chloroform, acetone and methanolic; *Salmonella paratyphi, Bacillus subtilis, Bacillus thuringiensis, Proteus mirabilis, Proteus vulgaris, Pseudomonas aeruginosa, Staphylococcus aureus* and *Escherichia coli*	Methanol; against all the pathogens tested; alkaloids, tannins, steroids, glycosides, saponins, phenols and flavonoids (Prabha and Vasantha, 2012)	NE
	Latex; Aqueous; Rats	CPE, FoPE; NA; AIA (Kumar and Basu, 1994)	Root and leaves; water, methanol and ethanol; *Pseudomonas aeruginosa, Salmonella typhi, Escherichia coli, Staphylococcus aureus* and *Streptococcus pyrogenes*	Aqueous; alkaloids, flavonoids, tannins, saponins, and cardiac glycosides balsams and volatile oil and steroids (Mainasara et al., 2012)	
Cannabis sativa L.	Seeds; Petroleum oil; Male and female albino rats (100–130 g)	CPE (0.5 and 1 ml/kg bw); Reference drug, Indomethacin (10 mg/kg bw); AIA (Musa et al., 2011)	Leaves; ethanol. Methanol, aqueous benzene; *Pseudomonas, Staphylococcus, Escherichia coli, Klebsiella*	NA; Tannins, terpenoids and reducing sugars (V. Kumar et al., 2011)	2-dodecanone [oil]; Antifungal agent. Cannabidiol and cannabigerolic acid; Antibiotic properties. 1-(3,5-Dihydroxyphenyl)-2-(4-hydroxyphenyl)ethane; Phytoalexin. 3-(3,7-Dimethyl-2,6-octadienyl)-2,4-dihydroxy-6-pentylbenzoic acid; Antibiotic.
Cassia fistula L.	Bark; Methanolic and aqueous; Wistar albino rats (170–200 g) of either sex	CPE (250 and 500 mg/kg bw); Reference drug, Diclofenac sodium (5 mg/kg bw); AIA (Ilavarasan et al., 2005)	Leaves; Hydroalcohol; *Staphylococcus aureus*, *Streptococcus pyogenes*, *Escherichia coli*, *Pseudomonas aeruginosa*, *Aspergillus niger*, *Aspergillus clavatus*, *Candida albicans*	Hydroalcohol; against all the pathogens tested; Tannins, flavonoids, saponins, triterpenoids, steroids, glycosides, anthraquinones, reducing sugars, carbohydrates, proteins, amino acids (Bhalodia and Shukla, 2011)	2-Hentriacontanone and 5-Nonatetracontanone [pods]; Antibacterial agents. Celastrol; Cytotoxic and antibacterial agent.

Table 4 (*continued*)

Plant species	Antiinflammatory studies		Microbiological studies		Active compound [Plant part]; Biological activity related to skin problems (DNP, 2014)
	Plant part; Extract; Animal (Weight)	**Animal Model (Dose); Reference control; Activity [Source for columns 2 & 3]**	**Plant part tested; Solvent or extracts used: Tested against (micro-organism)**	**Effective extract; Most effective against; Phytoconstituents [Source for columns 4 and 5]**	
Celastrus paniculatus Willd.	Seeds; Alcoholic and methanolic; Albino mice (25–32 g)	CPE (500 mg/kg bw); Reference drug, Diclofenac sodium (50 mg/kg bw); AIA (Parimala et al., 2009)	Oil: Bacterial such as *Escherichia coli, Staphylococcus aureus, Bacillus cereus, Salmonella dysentrica, Klebsiella pneumoniae, Proteus vulgaris* and Fungi such as *Aspergillus niger, Aspergillus flavus, Penicillin* sp. and *Trichoderma* sp.	Oil; Weak activity against *Proteus vulgaris, Staphylococcus aureus, Salmonella dysentrica* (Patel and Trivedi, 1962)	
			Seed; Aqueous, ethanolic; Fungi such as *Fusarium oxysporum, Aspergillus terreus, Curvularia lunata* and *Alternaria solani* and Bacteria such as *Bacillus subtilis* (strain APR-4) and *Escherichia coli* (EC-1).	Aqueous; *Fusarium oxysporum, Aspergellu terreus, Curvularia lunata* (Parkash and Sandhu, 2012)	
Chrysopogon zizanioides (L.) Roberty	Root; n-Hexane, chloroform, ethyl acetate and butanol; Male Wistar albino rats (250–300 g)	CPE; Reference drug, Diclofenac sodium (10 mg/kg bw); AIA (Kamble et al., 2013)	Plant; Ethanolic and aqueous; *Staphylococcus aureus, Escherichia coli, Pseudomonas aeruginosa*, and *Bacillus subtitils*	Ethanol; *Escherichia coli*, *Pseudomonas aeruginosa*; flavanoids, glycosides, phenols, tannins, saponins and alkaloids (Devprakash et al., 2011)	NE
Cissampelos pareira L.	Roots; Ethanolic; Rats	CPE, FoPE, HPE, CPG (200 and 400 mg/kg bw); NA; Significant AIA (Amresh et al., 2007b)	Roots; Methanol; *Escherichia coli, Pseudomonas aeuroginosa, Staphylococcus aureus, Bacillus subtillis*	Methanol; *Bacillus subtilis;* Tannins, flavonoids, steroids (Kumar et al., 2012)	Cycleanine; Antiinflammatory properties.
					Grandirubrine; Shows potent cytotoxic activity.
					Norrufescine; Exhibits cytotoxicity against P388 cells.
Cleome viscosa L.	Flowers; Quercetin 3-O-(2″-acetyl)-glucoside obtained from ethyl acetate fraction	CPE; NA; AIA (Senthamilselvi et al., 2012)	Seeds; Petroleum ether, chloroform, ethyl acetate, ethanol and water; *Staphylococcus aureus, Bacillus subtillis, Escherichia coli, Pseudomonas aureginosa* and four fungal species *Aspergillus niger, Sacromyces cerviceae, Aspergillus flavous, Candida albicans*	Chloroform, ethyl acetate, ethanol; all tested microorganisms; NA (Wake et al., 2011)	Isoliquiritigenin; Antitumour promoter, antioxidant, antiinflammatory, antimutagenic and antifungal activity.
					2-Amino-9-(4-oxo-2-azetidinyl) and nonanoic acid [seed]; Antibacterial agents.
Clerodendrum infortunatum L.	Leaves; Methanol; Wistar strain rats of either sex (150–180 g)	CPE, HPE, DPE (250 and 500 mg/kg bw); Reference drug, Phenylbutazone (100 mg/kg bw); AIA (S. Das et al., 2010)	Leaves; Chloroform, ethanol, methanol, iso-amyl alcohol and propanol; *Bacillus subtilis, Proteus sp., Staphylococcus aureus, Klebsiella pneumoniae and Salmonella typhi*	e Iso-amyl Alcohol; *Bacillus subtilis* and *Staphylococcus aureus;* Glycosides, Terpeniods, Anthraquinones, Flavonoids, Saponins, Tannins, Lignin, Phenol and Alkaloids (Prasad et al., 2012)	NE
Commelina benghalensis L.	Leaves; Hydroethanolic; Wistar albino rats (150-200 g) and Swiss albino mice (25–30 g) of either sex	CPE, CPG, XPE (200 and 400 mg/kg bw); Reference drug, Indomethacin (10 mg/kg bw); AIA (Tiwari et al., 2013)	Whole plant; aqueous, ethanol; *Candida albicans, Escherichia coli, Staphylococcus aureus*	Ethanol; all tested microorganisms; alkaloids, lactones and coumarins, triterpenes and steroids, resins, reducing agents, phenols and tannins, amino acids, quinones, flavonoids and saponins (Cuellar et al., 2010)	NE
Crotalaria juncea L.	Leaves; Ethanolic; Male albino Wistar rats (150–250 g)	CFAA; NA; Significant AIA (Ashok et al., 2006)	Flower and seeds; Ethanol; *Escherichia coli, Enterococcus faecalis, Klebsiella pneumoniae, Pseudomonas aeruginosa, Shigella flexneri, Shigella dysenteriae, Staphylococcus aureus, Vibrio cholare*	Ethanol ; *Klebsiella pneumonia, Pseudomonas aeruginosa, Staphylococcus aureus;* steroids, triterpenes, flavonoids, phenolics and glycosides (Chouhan and Singh, 2010)	NE
Cryptolepis dubia (Burm. f.) M.R. Almeida	Aerial part; Ethanolic; Rat	CPE, CPG; NA; AIA (Laupattarakasem et al., 2006)	Leaves; Methanol; *Staphylococcus aureus, Staphylococcus epidermidis, Salmonella typhi, Salmonella paratyphi*	Methanol; Against all bacteria (Mahida and Mohan, 2007)	NE
					NE

Curculigo orchioides Gaertn.	Tubers; Methanolic; Adult Wistar albino rats (150–200 g) of either sex	CPE (200 and 400 mg/kg bw); Reference drug, Diclofenac sodium (15 mg/kg bw); AIA (Agrahari et al., 2010b)	Roots; Methanol, acetonitrile, chloroform, hexane; *Pseudomonas aeruginosa, Staphylococcus aureus*, *Klebsiella pneumonia*	Methanol; *Pseudomonas aeruginosa*; Saponins (Singh and Gupta, 2008)	
Cuscuta reflexa Roxb.	Stem; Alcoholic and aqueous; Wistar albino rats of either sex (150–200 g) and albino mice (16–25 g)	HPE (100, 200 and 400 mg/kg bw); Reference drug, Ibuprofen (40 mg/kg bw); AIA (Katiyar et al., 2012)	Stem; Ethanol; Gram positive bacteria *Staphylococcus aureus, Bacillus subtilis* and Gram negative bacteria *Escherichia coli, Pseudomonas aeroginosa* Fungi *Penicillium citrium, Aspargillus niger*	Ethanol;Gram negative bacteria and fungi; Alkaloids, carbohydrates, some glycosides, flavonoids, tannins, phenolic compounds, steroids (Inamdae et al., 2011)	NE
Cynodon dactylon (L.) Pers.	Whole plant; Chloroform, methanolic	CPE; Reference drug, Indomethacin (5 mg/kg bw); AIA (Yogesh et al., 2013)	Leaves; Acetone, ethanol, propanol; *Bacillus subtilis, Enterobacter aerogenes*, *Escherichia coli*, *Klebsiella pneumoniae*, *Proteus vulgaris*, *Pseudomonas aeruginosa*, *Salmonella typhi*, *Shigella* sp., *Staphylococcus aureus, Streptococcus* sp.	Acetone; *Enterobacter aerogenes;* Alkaloids, phytosterols, tannins (Hema et al., 2013)	NE
Dalbergia sissoo DC.	Leaves; Ethanolic; Rats	CPE, KPE, NPE, CPG (100, 300 and 1000 mg/kg bw); NA; Significant AIA (Hajare et al., 2001)	Leaves; Chloroform, ethyl acetate, acetone, methanol; *Escherichia coli*, *Staphylococcus aureus, Pseudomonas aeruginosa*	Methanol; *Staphylococcus aureus, Pseudomonas aeruginosa* (Prasad et al., 2014)	4-Methoxydalbergione, 3,5-Dihydroxystilbene; Antifungal and antibacterial agents. 1,2,4,5-Tetrahydroxy-7-methylanthraquinone; Antifungal agent.
Datura stramonium L.	Leaves; Ethanolic; Albino Wister rats of either sex (100–160 g)	CPE (50, 100 and 200 mg/kg bw); Reference drug, Diclofenac sodium (5 mg/kg bw) (Gupta et al., 2010)	Aerial parts; Methanol; Bacillus subtilis, *Staphylococcus aureus*, *Escherichia coli, Enterococous faecalis, Pseudomonas aeruginosa* Stem bark; Aqueous, ethanol; *Staphylococcus aureus, Salmonella typhi, Shigella* spp., *Escherichia coli, Klebsiella pneumoniae, Nisseria gonorrhoeae*	Methanol; Slight antibacterial property (Eftekhar et al., 2005) Ethanol; *Staphylococcus aureus, Salmonella typhi, Shigella* spp., *Escherichia coli, Klebsiellapneumoniae*; Saponins, tannins, steroids, alkaloids, flavonoids, phenols and glycosides (Shagal et al., 2012)	NE
Dendrophthoe falcata (L.f.) Ettingsh.	Leaves; Aqueous and methanolic; Rats	CPE, CPG (300 mg/kg bw); Reference drug, Diclofenac sodium; AIA (Patil et al., 2011)	Aerial parts; Petroleum ether, chloroform and ethanol; *Staphylococcus aureus*, *Staphylococcus pyogenes*, *Staphylococcus epidermidis*, *Micrococcus luteus*, *Bacillus subtilis*, *Bacillus cereus*, *Klebsiella pneumoniae*, *Enterobacter aerogenes*, *Pseudomonas aeroginosa*, *Serratia marcescens*, and five fungi *Candida albicans*, *Candida tropicalis*: dimorphic fungi, *Aspergillus fumigatus*, *Aspergillus niger*: systemic fungi, and some infectious bacteria *Escherichia coli* and *Salmonella typhi*	NE (Pattanayak and Sunita, 2008)	NE
Desmodium gangeticum (L.) DC.	Aerial parts and roots; Water decoction; Rats	CPE (5, 10 and 20 mg/kg bw); NA; AIA (Rathi et al., 2004)	Whole plant; Methanol, ethanol, chloroform and aqueous; *Klebsiella pneumoniae, Escherichia coli, Salmonella typhi, Streptococcus mutants* and *Pseudomonas aeruginosa*	Methanol; *Streptococcus mutans*; NA (Karthikeyan et al., 2012)	2′,4′,5,7-Tetrahydroxy-6-prenylisoflavanone and desmocarpin; Phytoalexin.
Desmostachya bipinnata (L.) Stapf	Root; Hydroalcoholic; Wister albino rats (160–190 g)	CPE (200, 300 and 400 mg/kg bw); Reference drug, Indomethacin (5 mg/kg bw); Significant AIA (V. Kumar et al., 2010)	Aerial part oil; *Staphylococcus aureus, Staphylococcus epidermidis, Escherichia coli* and *Pseudomonas auerigenosa*	Against all the tested organisms; Camphene, isobornyl acetate, tricyclene, (+,-) trans-2,6-gamma-Irone, Caryophyllene diepoxide, β-eudesmol, Eseroline and Calarene (K.A. Kumar et al., 2010)	NE
Dicliptera paniculata (Forssk.) I. Darbysh.	Leaves, stem, flowers, seeds and whole plant; Ethanolic; Sprague-Dawley rats (110–150 g) and albino mice (15–20 g) of either sex	CPE, CPG (50, 100, 200 mg/kg bw); Reference drug, Phenylbutazone (100 mg/kg bw); Dose dependent AIA (Rathi et al., 2003)	Leaves; chloroform, acetone, ethanol and water; *Bacillus subtilis, Staphylococcus aureus, Pseudomonus aeruginosa* and *fungal strains Aspergillus niger* and *Penicillum chrysogenum*	Acetone and ethanol; *Staphylococcus aureus* and *Bacillus subtilis;* NA (Hosamani et al., 2011)	NE
Eclipta prostrata (L.) L.	Leaves; Methanolic; Albino Wistar rats of either sex (160–180 g)	CPE (100 and 200 mg/kg bw); Reference drugs, Indomethacin (10 mg/kg bw) and cyproheptadine (8 mg/kg	Whole plant; ethyl acetate, ethanol, petroleum ether; *Klebsiella pneumoniae, Escherichia coli, Salmonella typhi* and *Pseudomonas aeruginosa, Bacillus cereus, micrococcus luteus, Candida albicans*	Ethyl acetate; Alkaloids, flavonoids, tannins, saponins (Sharma and Sharma, 2010)	Verazine; Antifungal agent.

Table 4 (*continued*)

Plant species	Antiinflammatory studies		Microbiological studies		Active compound [Plant part]; Biological activity related to skin problems (DNP, 2014)
	Plant part; Extract; Animal (Weight)	Animal Model (Dose); Reference control; Activity [Source for columns 2 & 3]	Plant part tested; Solvent or extracts used: Tested against (micro-organism)	Effective extract; Most effective against; Phytoconstituents [Source for columns 4 and 5]	
		bw); AIA (Arunachalam et al., 2009)			
Ehretia laevis Roxb.	NE	NE	NE	NE	NE
Eulaliopsis binata (Retz.) C.E.Hubb.	NE	NE	NE	NE	NE
Euphorbia hirta L.	Whole plant; Aqueous and ethanolic; Male albino Wistar rats (180–250 g)	CPE (100 and 200 mg/kg bw); Reference drug, Diclofenac sodium (50 mg/kg bw); AIA (P. Das et al., 2010)	Whole plant; Methanol, hexane, distilled water; *Escherichia coli*, *Klebsiell pneumonia*, *Salmonella dysentriae*, *Salmonella typhi*, *Proteus mirabilis* Roots, stem, bud, leaves; Ethanol, petroleum ether; *Staphylococcus aureus, Salmonell typhi, Pseudomonas aeruginosa, Vibrio cholera, Escherichia coli*	Aqueous; *Escherichia coli*, *Salmonell typhi;* Tannins, saponins, phenolics, flavonoids, cardiac glycosides, anthroquinones, alkaloids (Abubakar, 2009) Ethanol; *Salmonell typhi;* NA (Saravanan et al., 2012)	NE
Euphorbia thymifolia L.	Whole plant; Ethanolic; Wistar albino rats (150–200 g) of either sex	CPE (100 mg/kg bw); Reference drug, Indomethacin (10 mg/kg bw); AIA (Garipelli et al., 2012)	Whole plant; Fresh juice, latex, methanol, ethanol, DCM, aqueous; *Bacillus pumilus, Staphylococcus, pneumoniae, Escherichia coli, Citrobacter freundii, Klebsiell pneumonia, Candida albicans, Aspergillus niger*	Fresh juice; *Bacillus pumilus, Staphylococcus aureus, Streptococcus pneumoniae, Escherichia coli, Citrobacter freundii, Klebsiell pneumonia*; Tannins, alkaloids, flavanoids (Hussain et al., 2014)	Tellimagrandin II; Antifungal and antiviral agent.
Ficus benghalensis L.	Bark; Aqueous, alcoholic; chloroform	HRBC [100 and 200 mg/ml]; Reference drug, Diclofenac sodium; AIA (Matpal et al., 2013)	Roots; Aqueous, ethanol; *Staphylococcus aureus, Pseudomonas aeruginosa, Klebsiell pneumonia*	Ethanol; *Staphylococcus aureus;* NA (Murti and Kumar, 2011)	NE
Ficus racemosa L.	Leaves; Rat	CPE, SPE, HPE, DPE (200 and 400 mg/kg bw); Reference drug, Phenylbutazone; AIA (Mandal et al., 2000)	Roots; Aqueous, ethanol; *Staphylococcus aureus, Pseudomonas aeruginosa, Klebsiell pneumonia*	Ethanol; *Staphylococcus aureus;* NA (Murti and Kumar, 2011)	Racemosic acid; Anti-inflammatory and antioxidant properties.
			Roots; Methanol; *Escherichia coli, Pseudomonas aeuroginosa, Staphylococcus aureus, Bacillus subtilis*	*Bacillus subtilis;* Tannins, flavonoids, steroids (Kumar et al., 2012)	
Ficus religiosa L.	Bark; Methanolic; Wistar albino male rats (170–190 g) and Swiss albino male mice (27–5 g)	CPE (125, 250 and 500 mg/kg bw); Reference drug, Indomethacin (5 mg/kg bw); AIA (Sreelekshmi et al., 2007)	Bark and leaves; Diethyl ether and methanol; *Escherichia coli, Staphylococcus aureus, Pseudomonas aurignosa* and *Aspergillus niger*	Methanol extract of bark and leaves; *Escherichia coli, Staphylococcus aureus, Pseudomonas aurignosa* and *Aspergillus niger* (Ramakrishnaiah and Hariprasad, 2012)	Bergaptol; Anti-inflammatory and antifungal agent.
Holarrhena pubescens Wall. ex G. Don	Seeds; Ethanolic; Albino Wistar rats (180–200 g) of either sex	CPE, CPG (100, 200 and 400 mg/kg bw); Reference drug, Indomethacin (10 mg/kg bw); AIA (Saha and Subrahmanyam, 2013)	Bark; Methanol; *Bacillus cereus, Bacillus subtilis, Bacillus thuringiensis, Staphylococcus epidermidis, Staphylococcus saprophyticus, Staphylococcus aureus, Corynebacterium hoffmanii, Corynebacterium xerosis, Streptococcus faecalis, Micrococcus luteus, Escherichia coli, Salmonella typhi*	Methanol; *Micrococcus luteus;* NA (Siddiqui et al., 2012)	NE
Holoptelea integrifolia Planch.	Leaves; Ethanolic; Wistar rats (180–200 g) and Swiss albino mice (18–22 g) of either sex	CPE, DPE, HPE, SPE, CPG (250 and 500 mg/kg bw); Reference drug, Indomethacin (10 mg/kg bw); AIA (Kalpana and Upadhyay, 2010)	Stem bark; Petroleum ether, benzene, chloroform, methanol and aqueous; *Staphylococcus aureus, Escherichia coli, Bacillus subtilis, Pseudomonas aeruginosa*	Chloroform; against all the tested microorganisms; NA [Nadella and Paarakh, 2011)	1,4-Naphthoquinone; Antibacterial agent.
Hyptis suaveolens (L.) Poit.	Leaves; Suaveolol and Methyl suaveolate from leaves; Rat	CODE; Reference drug, Indomethacin; AIA (Grassi et al., 2006)	Whole plant; Aqueous and ethanol; Fungi *Canidida albicans, Collectrotrichum capsici, Fusarium oxysporum F. sp. Lycopersici,* and four bacteria *Klebsiella pneumoneae, Staphylococcus*	Ethanol; against all the tested microorganisms; volatile oil, starch, proteins, tannins, saponins, fats, alkaloids and glycosides (Pachkore et al., 2011)	NE

			aureus, Escherichia coli and *Pseudomonas aeruginosa*		
Ipomoea carnea Jacq.	Leaves; Aqueous; Albino Wistar rats of either sex	CPE (250 and 500 mg/kg bw); Reference standard, Etoricoxib intraperitoneal (6 mg/kg bw); AIA (Khalid et al., 2011)	Leaves; n-hexane, ethyl acetate, acetone, ethanol and acetone; *Escherichia coli, Staphylococcus aureus, Salmonella typhimurium, Pseudomonas aeruginosa, Proteus vulgaris, Bacillus cereus*	Acetone and ethanol; *Ptroteus vulgaris, Salmonella typhimurium* and *Pseudomonous auroginosa*; NA (Adsull et al., 2012)	NE
Lannea coromandelica (Houtt.) Merr.	Bark; Ethanolic; Rat	CPE, DPE; NA; AIA (Singh and Singh, 2006)	Bark; ethanol, aqueous; *Streptococcus pyogens, Staphylococcus aureus* and *Candida albicans*	Both; against all the tested microorganisms; NA (Kaur et al., 2013)	NE
Lantana camara L.	Aerial parts; Aqueous; Albino rats (200–250 g) of either sex	CPE (300 and 500 mg/kg bw); Reference drug, Ibuprofen (100 mg/kg bw); AIA (Gidwani et al., 2009)	Methanol, ethanol and water; leaves; Four Gram positive and Gram negative bacterial isolates *Staphylococcus aureus, Pseudomonas aeruginosa, Klebsiella pneumoniae, Bacillus subtilis* and two fungal strains *Aspergillus fumigatus* and *Aspergillus flavus*	Methanol; *Staphylococcus aureus* and *Pseudomonas aeruginosa*; Phenolic, Flavonoids, Tannin, Saponin (Naz and Bano, 2013)	Lantic acid and 2,10-Bisaboladien-1-one; Antibacterial agents.
			Leaves; Methanol, Petroleum ether, water and Chloroform; *Escherichia coli, Pseudomonas aeruginosa, Staphylococcus aureus* and *Staphylococcus saprophiticus*	Methanol; against all the tested microorganisms; tannin, catachin, saponin, steroids, alkaloids, phenol, anthroquinone, protein and reducing sugar (Mary, 2011)	
Lawsonia inermis L.	NA; A pure compound lawsone isolated from the chloroform extract; Rat	500 mg/kg bw; Reference drug, Phenylbutazone (100 mg/kg bw); AIA (Alia et al., 1995)	Leaves; Methanol; *Gram positive; Bacillus subtilius, Staphylococcus aureus and Staphylococcus epidermidis* and Gram negative; *Escherichia coli, Shigella flexneri, Pseudomonas aeruginosa bacteria*	Methanol; against all the tested microorganisms; glycosides, phytosterol, steroids, saponins, tannins and flavonoids (Raja et al., 2013)	Lalioside; Antimicrobial agent.
Leonotis nepetifolia (L.) R.Br.	Aerial parts; Hexane, ethyl acetate and methanolic; Male CD-1 mice (20–25 g)	TPAPE; NA; AIA (Parra-Delgado et al., 2004)	Leaves,stem, inflorescence and root; Petroleum ether, Ethyl acetate and methanol; Gram-negative bacteria *Escherichia coli, Pseudomonas aeruginosa, Salmonella typhimurium, Klebsiella pneumonia,* gram-positive bacteria *Bacillus cereus, bacillus subtilis, Micrococcus luteus, Staphylococcus aureus* and one fungal strain *Candida albicans*	Methanol; against all the tested microorganisms; alkaloids, steroids, saponins, tannins, flavanoids, coumarins, volatile oils, glycosides, terpenoids, phenols and glycosides (Gnaneswari and Raju, 2012)	NE
			Leaves, flower, stem; Methanol; *Escherichia coli, Pseudomonas aeruginosa, Staphylococcus aureus, bacillus subtilis, Micrococcous luteus, Vibrio cholera, Shigella flexneri, Shigella dysenteriae.*	Methanol*; Bacillus subtilis, Micrococcous luteus;* alkaloids, saponins, tannins, terpenoids (Sinha, 2012)	
Linum usitatissimum L.	Fixed oil; Wistar strain albino rats (100–150 g) and Swiss albino mice (20–25 g)	CPE, PGPE, AAPE, LPE, HPE, BKPE (3.0 and 2.85 g/kg bw); Reference drugs different as per model; AIA (Kaithwas et al., 2011)	Seeds; Petroleum ether, chloroform, aqueous, ethanol; Gram-positive and negative bacteria *Staphylococcus aureus, Bacillus cereus, Klebsiella pneumoniae* and *Pseudomonas aeruginosa*	Petroleum ether; against all the tested microorganisms; NA (Al-Bayati, 2007)	Secoisolariciresinol; Anticancer and antioxidant agent.
					Cyclolinopeptide A; Possesses good cytoprotective properties.
Litsea glutinosa (Lour.) C.B. Rob.	NA; Aqueous; Wistar rats (100–175 g) of either sex	CPE, HPE, DPE; Reference drug, Indomethacin (10 mg/kg bw); AIA (Devi and Meera, 2010)	Bark; Petroleum ether, Ethanol, aqueous; Gram positive *Staphylococcus aureus,* Gram negative like *Pseudomonas aeruginosa, Salmonella typhi, E-coli* and fungal species *Aspergillus fumigatus* and *Candida albicans*	Petroleum ether & Ethanolic; *Pseudomonas aeruginosa*; Alkaloids, Proteins, Carbohydrates, Cardiac glycosides, Saponins, Tannins & Phenolics (Hosamath, 2011)	Cassythicine; Antimicrobial agent.
Mallotus philippensis (Lam.) Mull. Arg.	Whole plant; 11-O-galloylbergenin isolated from ethanolic extract; Rats	CPE (10, 20 and 30 mg/kg bw); NA; AIA (Arfan et al., 2010)	Whole plant; Hexane, chloroform, ethyl acetate, butanol and aqueous; *Bacillus subtilis, Staphylococcus aureus, Staphylococcus pneumonia, Pseudomonas aeruginosa, Proteus vulgaris, Salmonella typhi, Aspergillus flavus, Aspergillus niger* and *Candida albicans*	Ethyl acetate, butanol; against all the tested microorganisms; alkaloids, flavonoids, glycosides, phenols, quinines, saponins, tannins and terpenoids (Afzal et al., 2013)	NE
Martynia annua L.	NE	NE	Leaves; Chloroform, ethyl acetate and methanol; *Streptococcus faecalis, Streptococcous pyogenes, Enterococcous faecalis, Bacillus subtilis, Bacillus thuringities, Klebsiella pneunomiae,*	In Chloroform extract the activity was high in *Proteus vulgaris*; In Ethyl acetate *Salmonella paratyphi*. A, B., Proteus mirabilis, P.vulgaris and Klebsiella pneumoniae. In Methnol extract,	NE

Table 4 (*continued*)

Plant species	Antiinflammatory studies		Microbiological studies		Active compound [Plant part]; Biological activity related to skin problems (DNP, 2014)
	Plant part; Extract; Animal (Weight)	Animal Model (Dose); Reference control; Activity [Source for columns 2 & 3]	Plant part tested; Solvent or extracts used: Tested against (micro-organism)	Effective extract; Most effective against; Phytoconstituents [Source for columns 4 and 5]	
			Proteus vulgaris, Proteus mirabilis, Salmonella paratyphi, Salmonella parathphi.A., Salmonella paratyphi.B	*Proteus vulgaris*, *Bacillus subtilis*, *Salmonella paratyphi.B.* and *Pseudomonas aeruginosa*; terpenoid, alkaloids, glycosides, steroids, tannins and saponins and moderate quantity of cardiac glycosides, phenols and anthroquinones (Sermakkani and Thangapandian, 2010)	
Millettia extensa (Benth.) Baker	NE	NE	NE	NE	NE
Mirabilis jalapa L.	Leaves; Aqueous; Albino Wistar rats of either sex (150–200 g)	CPE (200 and 400 mg/kg bw); Reference drug, Diclofenac sodium (10 mg/kg bw); AIA (M. Singh et al., 2010)	Leaves; Methanol, ethanol, petroleum ether and aqueous; *Staphylococcus aureus, Escherichia coli, Klebsiella pneumonia, Pseudomonas aeruginosa, Salmonella typhi* and *Proteus mirabilis*	Ethanol; *Pseudomonas aeruginosa*; alkaloids, saponins, tannins, and flavonoids (Akintobi et al., 2011)	2′-*O*-Methylabronisoflavone and 4-Hydroxy-9-*O*-methylboeravinone B; Antifungal agents. *Mirabilis jalapa* antimicrobial peptides; Antimicrobial and antifungal agent. *Mirabilis jalapa* Trypsin inhibitors; Trypsin inhibitor.
Mitragyna parvifolia (Roxb.) Korth.	Leaves; Ethanolic; Male Wistar rats (150–200 g) and Swiss mice (20–25 g) of either sex	CPE (100, 200 and 300 mg/kg bw); Reference drug, Phenylbutazone (80 mg/kg bw); AIA (Gupta et al., 2009)	Leaves; Ethanol; *Staphylococcus aureus*, *Bacillus subtilis*, *Escherichia coli* and *Pseudomonas aeruginosa*	Ethanol; *Staphylococcus aureus*, *Escherichia coli* and *Pseudomonas aeruginosa*; NA (Kaushik et al., 2009b)	Dihydrocorynantheol; Shows activity against Gram-positive bacteria. Corynantheine; Aniviral agent against influenza A.
Momordica dioica Roxb. ex Willd.	Fruit pulp; Hexane and ethyl acetate; Wistar albino mice (25-30 g) and rats (150-200 g) of either sex	CPE (50 and 100 mg/kg bw); Reference drug, Diclofenac sodium (5 mg/kg bw); Potential AIA (Ilango et al., 2003)	Fruit pulp; Hexane and ethyl acetate soluble portion of methanolic extract; Gram positive bacteria; *Bacillus cereus*, *Bacillus subtilis*, *Staphylococcus aureus* & *Staphylococcus epidermidis* and seven Gram negative bacteria; *Escherichia coli*, *Klebsiella pneumoniae*, *Proteus mirabilis*, *Proteus vulgaris*, *Pseudomonas aeruginosa*, *Salmonella typhi* and *Shigella dysenteriae*	Both extracts; *Salmonella typhi* and *Shigella dysenteriae*; secondary metabolites such as steroids, fatty acids in hexane extract (HE) and proteins, saponin glycosides and triterpenes (Ilango et al., 2012)	3,23-Dihydroxy-12-oleanen-28-oic acid; Epicarcinogen inhibitor.
	Leaf; Ethanol; Male Wistar rats (120–150 g)	CPE (200 mg/kg bw); Reference drug, Indomethacin (10 mg/kg bw; Significant AIA (Nagarani et al., 2014)			
Mucuna pruriens (L.) DC.	Aerial parts; Ethanolic; Swiss albino mice of either sex (20–25 g)	CPE, CPG (200, 400 mg/kg bw); Reference drug, Aspirin (150 mg/kg bw); AIA (Bala et al., 2011)	Root and seeds; hexane, petroleum ether, benzene, methanol and aqueous; *Staphylococcus aureus, Klebsiella pneumoniae, Bacillus subtilis, Pseudomonas aeruginosa, Salmonella typhi* and *Escherichia coli*	Benzene, methanol; against all the tested microorganisms; alkaloids, anthraquinones, flavonoids, phenols, tannins, terpenoids and xanthoprotein (Murugan and Mohan, 2011)	NE
Nicotiana plumbaginifolia Viv.	NE	NE	Leaves; Aqueous and methanol extracts; *Bacillus cereus, Bacillus fusiformis, Salmonella typhimurium Staphylococcus aureus* and *Pseudomonas aeruginosa*	Aqueous extract showed strongest activity on *Bacillus fusiformis* and methanol leaf extract also showed strongest activity on *Bacillus fusiformis*; alkaloids, saponin, tannin, flavonoides, cardiac glycosides, phenolic compounds, steroids, terpenoides and carbohydrates (K.P. Singh et al., 2010)	NE
	Root bark; Petroleum ether, chloroform, ethyl acetate and	CPE, CPG (100 and 300 mg/kg bw); Reference drug,		Dichloromethane; *Bacillus subtilis, Staphylococcus aureus;* Flavonoids (bacailein	Aloe emodin (shows antibacterial activity against methicillin resistant *Staphylococcus*

Oroxylum indicum (L.) Kurz	n-butanol; Swiss mice (18–22 g) and Wistar albino rats (200–250 g) of either sex	Diclofenac sodium (5 mg/kg bw); AIA (Zaveri and Jain, 2010)	Stem bark, root; Dichloromethane; *Bacillus subtilis, Staphylococcus aureus, Escherichia coli, Pseudomonas aeruginosa, Candida albicans*	and chrysin) and a naphthoquinone, lapachol (MatAli et al., 1998)	*aureus* (MRSA)) and oroxylin A (against gram-positive bacteria); Antibacterial agents.
			Root, stem; Alcohol; *Escherichia coli, Klebseilla* spp., *Proteus, Pseudomonas aeruginosa*, *Staphylococcus aureus*	Alcohol stem; *Staphylococcus aureus, Klebseilla* sps, *Proteus, Pseudomonas aeruginosa;* Alkaloids, phenols, fats, lipids, waxes (Radhika et al., 2011)	Chrysin; Shows antifungal and antiinflammatory activity. Active against *Pseudomonas aeruginosa* and*Candida albicans*. Oroxylin A; Shows antiinflammatory properties. Aloe emodin; Antimicrobial, antimutagenic and antiseptic agent. 4′,5,6,7-Tetrahydroxyflavone; Antioxidant. Chrysin; Antifungal agent.
Persicaria barbata (L.) H.Hara	Aerial parts; Petroleum ether, ethyl acetate and chloroform; Swiss albino mice (20–25 g) and long evans adult rats (130–170 g) of either sex	CPE (200 and 400 mg/kg bw); Reference drug, Phenylbutazone (100 mg/kg bw); AIA (Mazid et al., 2009)	NE	NE	NE
Phyllanthus amarus Schumach. and Thonn.	Whole plant; Methanolic; Male Wistar rats (150–200 g)	PAPE, CAP, CPG; Reference drug, Indomethacin; AIA (Mahat and Patil, 2007)	Leaves; Aqueous; *Staphylococcus aureus, Bacillus subtilis, Streptomyces albus, Streptococcus faecalis, Escherichia coli, Pseudomonas aeruginosa, Klebsiella pneumoniae, Proteus vulgaris*	Aqueous; *Staphylococcus aureus, Bacillus subtilis, Streptomyce albus, Escherichia coli;* Alkaloids, phytosterols, phenolic compounds and tannins, proteins and amino acids, lignins, saponins (Dhandapani et al., 2007)	3,3′,4,4′,9,9′-Hexahydroxylignan; Cytotoxicity enhancer.
Pongamia pinnata (L.) Pierre	Leaves; Ethanolic; Rat	CPE, HPE, HTPE, PGPE, KPE, FoPE, CPG (100, 300 and 1000 mg/kg bw); NA; AIA (Srinivasan et al., 2001)	Leaves; Petroleum ether, benzene, methanol and aqueous; *Escherichia coli, Staphylococcus aureus,Klebsiella pneumonia, Bacillus subtilis, Enterobacter aerogenes, Pseudomonas aeruginosa, Salmonella typhimurium, Salmonella typhi, Staphylococcus epidermis* and *Proteus vulgaeris*	Methanol; Carbohydrates, alkaloids, flavonoids glycosides, steroids, tannins and saponins (Arote et al., 2009)	Pongaflavone, 3-Me ether, 9,10-di-Ac and 6-*O*-Methylolivetonide (against *Mycobacterium tuberculosis*); Antibacterial agents.
			Cholroform, methanol, water; *Trichophyton rubrum, Trichophyton mentagrophytes, Trichophyton tonsurans, Microsporum gypseum, Microsporum fulvum*	Cholroform; against all tested microorganisms; NA (Sharma et al., 2012b)	Karanjabiflavone and α,β,2′,3,4,4′-Hexahydroxychalcone; Antioxidant.
Premna mollissima Roth	Leaves; Methanolic; Albino male Swiss mice (18–25 g) and Wistar Rat (150–180 g)	CPE, CPG (125, 250 and 500 mg/kg bw); Reference drug, Indomethacin (10 mg/kg bw); AIA (Mahire et al., 2009)	NE	NE	NE
Ranunculus sceleratus L.	Aerial parts; NA	TPAPE, AAPE, CPE; NA; AIA (Prietom et al., 2003)	Leaves; Cholroform, methanol, water; *Trichophyton rubrum, Trichophyton mentagrophytes, Trichophyton tonsurans, Microsporum gypseum, Microsporum fulvum*	Cholroform; against all tested microorganisms; NA (Sharma et al., 2012b)	NE
Rauvolfia serpentina (L.) Benth. ex Kurz	NE	NE	Leaves and roots; Ethanol; *Escherichia coli*, *Bacillus subtilis*, *Salmonella typhi* and *Staphylococcusaureus*	Ethanol; root extract against *S. typhii*; carbohydrates, tannins, saponins, flavonoids, alkaloids and starch soluble compounds are present and four indole alkaloids reserpine, ajmalicine, ajmaline and yohimbine (Deshmukh et al., 2012)	NE
Ricinus communis L.	Roots; Methanolic; Wister albino rats	CPE, CPG (250 and 500 mg/kg bw); NA; AIA (Ilavarasan et al., 2006)	Leaf; Methanol, ethanol and water; Gram positive bacteria (*Bacillus subtilis* and *Staphylococcus aureus*) as well as Gram negative bacteria (*Pseudomonas aeruginosa* and *Klebsiella pneumoniae*) and fungal strains *Aspergillus fumigatus* and *Aspergillus flavus*.	Methanol; NA (Naz and Bano, 2012)	Casbene [seed]; Antifungal agent.
Scoparia dulcis L.	Whole plant; Ethanolic; Mice	CPE (0.5 and 1.0 g/kg); NA; AIA (Tsai et al., 2011)	Whole plant; Aqueous and ethanolic; *Stapylococcus aureus*, *Microsporum canis*, *Candida albicans*, *Salmonella typhi*, *Streptococcus species*, *Escherichia coli* and *Proteus vulgaris*	Ethanol; Saponins, glycoside and carbohydrate (Yisa, 2009)	6,16-Dihydroxy-18-aphidicolanoic acid; Shows antiviral activity towards Herpes simplex and cytotoxic activity to HeLa cells.
		CPE, CPG (150 mg/kg bw); Reference drug, Indomethacin		Petroleum Ether; against all the tested organisms; Phenols, Triterepenoids, Steroids,	Scopadulcic acid A; Antitumour agent. 3-Pentadecyl-1,2-benzenediol; Antibacterial agent, cytotoxic to human cancer cells.

Table 4 (*continued*)

Plant species	Antiinflammatory studies		Microbiological studies		Active compound [Plant part]; Biological activity related to skin problems (DNP, 2014)
	Plant part; Extract; Animal (Weight)	Animal Model (Dose); Reference control; Activity [Source for columns 2 & 3]	Plant part tested; Solvent or extracts used: Tested against (micro-organism)	Effective extract; Most effective against; Phytoconstituents [Source for columns 4 and 5]	
Semecarpus anacardium L. f.	Nuts; Milk and Clarified butter; Adult male Wistar rats (180 and 200 g)	(10 mg/kg bw); AIA (Ramprasath et al., 2005)	Nut; Petroleum Ether; *Escherichia coli, Micrococcus luteus, Salmonella typhi, Bacillus subtilis* and *Klebsiella pneumonia* Nut; Alcoholic; *Aspergillus fumigates; Candida albicans*	Alkaloids, Flavonoids, Saponins, Tannins and Anthraquinones (Bagewadi et al., 2012) Alcoholic; NA (Sharma et al., 2002)	
Senna tora (L.) Roxb.	Leaves; Methanolic; Rats	CPE, HPE, SPE, DPE (400 mg/kg bw); NA; AIA (Maity et al., 1998)	Leaves; Hexane, chloroform and methanol, ethyl acetate; Bacteria *Bacillus subtilis, Staphylococcus aureus, Pseudomonas aeruginosa Proteus vulgaris, Escherichia coli,* Fungi *Candida albicans, Aspergillus niger, Fusarium oxysporum* and *Rhizopus oryzae*	Hexane; *Escherichia coli* Ethyl acetate *Aspergillus niger;* Phenolics, flavonoids, tannins and anthraquinons (John et al., 2011)	2-Acetyl-1,6,8-trihydroxy-3-methylnaphthalene (strong activity against methicillin-resistant *Staphylococcus aureus*) and toralactone (against methicillin-resistant *Staphylococcus aureus*) [seed]; Antibacterial agents. 1,2,6,8-Tetrahydroxy-3-methylanthraquinone; Antioxidant. Toralactone [seed]; Antimicrobial agent.
Sesamum indicum L.	Seed; Oil; Male Wistar rats (180–220 g) and male Swiss albino mice (25–30 g) Seed; oil; Wister albino rats (150–200 g) and Swiss albino mice (25–30 g)	CPE (100, 200 and 300 mg/kg bw); NA; AIA (Monteiro et al., 2014) CPE (5 and 10 ml/g bw); Reference drug, Diclofenac sodium (10 mg/kg bw); AIA (Saleem et al., 2011)	NE	NE	2,3′,4,4′,5-Pentahydroxy-7,9′:7′,9-diepoxylignan [Seed], Sesamolinol [Seed]; Antioxidant. 2-Chloro-5,8-dihydroxy-3-prenyl-1,4-naphthoquinone [Root]; Antifungal agent.
Shorea robusta Gaertn.	Resin; Ethanolic; Male albino rats (150–250 g)	CPE, CPG (30, 100 and 300 mg/kg bw); Reference drug, Etoricoxib (10 mg/kg bw); AIA (Wani et al., 2012b)	Oleoresin; Aqueous, methanol, petroleum and benzene; *Bacillus subtilis, Bacillus licheniformis, Bacillus coagulans, Bacillus cereus, Staphylococcus aureus, Staphylococcus epidermidis, Staphylococcus griseus, Escherichia coli, Proteus vulgaris, Pseudomonas fluorescens, Aspergillus flavus, Aspergillus niger, Candida albicans, Penicillium chrysogenum* Floral parts; Aqueous; *Staphylococcus aureus, Bacillus subtilis, Klebsiella pneumonia, Serratia marcescens*	Aqueous; *Bacillus coagulans, Escherichia coli, Bacillus cereus;* Alkaloids, carboxylic acids, fatty acids, phenols, saponins, steroids (Murthy et al., 2011) Aqueous; All; Tannins, flavanoids, cardiac glycosides, steroids (Duddukuri et al., 2011)	Chebulinic acid [Seed]; Antioxidant. NE
Sida cordata (Burm. F.) Borss. Waalk.	NE	NE	NE	NE	NE
Sida rhombifolia L.	Leaves; Hydroalcoholic; Rat	CPE (400 mg/kg bw); Reference drug, Indomethacin (10 mg/kg bw); AIA (Khalil et al., 2006)	NE	NE	NE
Solanum incanum L.	NE	NE	NE	NE	Spirosol-5-en-3-ol; Cytotoxic agent.
Terminalia arjuna (Roxb. ex DC.) Wight & Arn.	Leaves; Methanolic; Adult male Swiss albino mice (20 ± 2 g)	CPE, DPE, HPE (100, 200 mg/kg bw); Reference drug, Indomethacin (10 mg/kg bw); AIA (Biswas et al., 2011b)	Stem barks; Methanol; *Bacillus subtilis, Staphylococcus aureus, Escherichia coli, Pseudomonas aeruginosa, Klebsiella pneumoneae, Salmonella typhii, Proteus mirabilis, Micrococcus* sp.	Methanol; *Staphylococcus aureus;* Alkaloids, glycosides, flavonoids, flavanols, phenols, saponins, terpenoids (Patil and Gaikwad, 2011)	2,3,23-Trihydroxy-12-oleanen-28-oic acid; Skin tumour proliferation inhibitor. Punicalin; Moderate cytotoxic agent. 1,2,3,4,6,7-Naphthalenehexol; Antioxidant.
Tridax procumbens (L.) L.	Leaves; Aqueous; Male and female albino rats (130–170 g)	CPE (400 mg/kg bw); Reference drug, Ibuprofen; AIA (Awasthi et al., 2009)	Leaves; Methanol, ethyl acetate; *Escherichia coli, Klebsiella pneumoniae, Salmonella typhi, Bacillus cereus, Staphylococcusaureus* NE	Ethyl acetate; *Staphylococcus aureus*; Alkaloids, flavanoids, glycosides (Bharathi et al., 2012) NE	NE NE

Typha domingensis Pers.	Leaves; Petroleum ether and methanolic; Albino Wistar rats (100–150 g)	CPE, HPE (100, 200, 400 mg/kg bw); Reference drug, Diclofenac sodium (10 mg/kg bw); AIA (Pawar et al., 2011)			
Vallaris solanacea (Roth) Kuntze	Leaves; Methanolic; Albino rats of either sex (150–200 g)	CPE (250, 500 mg/kg bw); Reference drug, Indomethacin (100 mg/kg bw); AIA (Joshi et al., 2014)	Chloroform, ethanol, Petroleum ether; Gram positive- *Staphylococcus aureus, Bacillus subtilis* and gram negative – *Salmonella typhi* and *Escherichia coli,* Fungus like *Candida albicans* and *Aspergillus niger*	Petroleum ether; *Salmonella typhi*, *Escherichia coli*, *Aspergillus niger* and *Candida albicans*; NA (Vagdevi et al., 2011)	NE
Vanda tessellata (Roxb.) Hook. ex G.Don.	NE	NE	Leaves; Chloroform, petroleum ether, ethylacetate, acetone and methanol; *Staphylococcus aureus, Bacillus subtilis, Escherichia coli, Klebsiella pneumoneae, Proteus mirabilis* and *Candida albicans*	Ethyl acetate; *Staphylococcus aureus, Escherichia coli, Klebsiella pneumoneae* and *Candida albicans* (Gupta and Katewa, 2012)	NE
Verbascum thapsus L.	NE	NE	NE	NE	Aucubigenin; Antibacterial and phytotoxic agent. 11,13(18)-Oleanadiene-3,16,23,28-tetrol; Antiinflammatory properties.
Vitex negundo L.	Seeds; Chloroform; Sprague-Dawley male rats (100–160 g)	CPE (500 mg/kg); Reference drug, Ibuprofen (50 mg/kg bw); AIA (Chawla et al., 1992)	Leaves; Benzene, chloroform, ethanol, water-ethanol (50:50), water; *Staphylococcus aureus, Proteus vulgaris, Bacillus subtilis, Escherichia coli, Pseudomonas aerugenosa, Aspergillus niger, Aspergillus flavon, Candida albicans*	Water-ethanol (50:50); showed maximum anti microbial, Water; showed maximum antifungal activity; α-pinene, camphene, caryophyllene, citral, glycosides like negundoside, nishinadaside, other hydroxybenzoylmussaenosidic acid derivatives (Aswar et al., 2009)	Vitegnoside and Vitelignin A [leaf]; Antifungal agents. Vitexilactone; Antibacterial and antifungal agent. Vitedoamine A and Vitedoin A; Antioxidant.
Wrightia arborea (Dennst.) Mabb.	Leaves; Methanolic; Male albino rats (120–140 g)	FPE, CPE (100, 200 mg/kg bw); Reference drug, Indomethacin (10 mg/kg bw); AIA (Nahar et al., 2013)	Bark; Petroleum ether, chloroform, acetone and methanol; *Bacillus subtilis, Bacillus megaterium, Escherichia coli, Klebsiella planticola, Micrococcus luteus, Pseudomonas aeruginosa Staphylococcus aureus* and *Salmonella typhi*	Chloroform *; Micrococcus luteus*, *Staphylococcus aureus, Salmonella typhi* and *Pseudomonas aeruginosa*; alkaloids, phenolics, saponins, flavonoids and tannins (Khyade and Vaikos, 2011)	NE
Ziziphus nummularia (Burm. f.) Wight & Arn.	Leaves; Alkaloids; Wistar rats of both sexes (180–200 g) and Swiss mice (20–24 g)	CPE, HPE, DPE, SPE, CPG, CIP (10, 20, 30 mg/kg bw oral); NA; 30 mg/kg bw shows anti-oedematogenic effect (Goyal et al., 2013)	Leaves; Aqueous, ethanol; *Staphylococcus aureus, Streptococcus pyogenes, Bacillus subtilis, Pseudomonas aeruginosa, Aspergillus niger, Aspergillus flavus, Candida albicans, Trichophyton rubrum*	Ethanol; *Staphylococcu aureus* and fungi *Trichophyton rubrum*; NA (Gautam et al., 2011)	NE

Abbreviations: AAPE=arachidonic acid (AA) induced paw edema model, AIA=anti-inflammatory activity, APE=adjuvant induced paw edema model, BKPE=Bradykinin induced paw edema model, CAP=carrageenan air pouch model, CFAA=complete Freund's adjuvant (CFA) induced arthritis model, CIP=carrageenan induced peritonitis model, CODE=Croton oil induced dermatitis of the mouse ear model, CPE=carrageenan induced paw edema model, CPG=cotton pellet granuloma model, DPE=dextran induced paw edema model, FoPE=formaldehyde induced paw edema model, FPE=formaline induced paw edema model, HPE=histamine induced paw edema model, HRBC=human blood cell membrane stabilization method, HTPE=5-hydroxytryptamine induced paw edema model, IPE=immunologically induced paw edema model, KPE=Kaolin induced paw edema model, LPE=leukotriene induced paw edema model, NE=not evaluated, NPE=Nystatin induced paw edema model, PAPE=phlogistic agents induced paw edema model, PGNIN=peptidoglycan (PGN) induced inflammatory reaction, PGPE=prostaglandin E2 induced paw edema model, PPCIN=polyinosinic: polycytidylic acid (polyI:C) induced inflammatory reaction, SPE=serotonin induced paw edema model, TPAPE=tetradecanoylphorbol acetate (TPA) induced paw edema model, XEE=xylene induced ear edema model.

Quercetin, the active ingredient, has been shown in *in vitro* studies to decrease fibroblast proliferation, inflammation, extracellular matrix deposition, and stabilized mast cells (Pawlikowska-Pawlega and Gawron, 1995; Ho et al., 2006; Cho et al., 2010). A prospective, double-blinded, split-scar study on 20 Asians who had new Pfannenstiel's cesarean section scars was conducted to assess efficacy of onion gel containing 12% *Allium cepa* L. (Erase gel, ABCA Pharma Lab Co., Ltd., Nonthaburi, Thailand) and results showed improvement of scar height and scar symptoms (Chanprapaph et al., 2012). The randomized, controlled, single-blind study on 44 healthy male and female aged 18–70 years evaluated the appearance of new dermal scars after eight weeks of once-daily application of non-prescription proprietary onion extract gel formulation (Mederma®, Merz Pharmaceuticals, LLC, Greensboro, North Carolina), the study showed that this proprietary onion extract gel is safe and significantly improves scar appearance after four weeks of once-daily application (Draelos et al., 2012).

Amaranthus spinosus L. has shown wound healing, antiinflammatory, antioxidant and antimicrobial properties in the earlier studies (Tables 3 and 4). The methanol extracts of *Amaranthus spinosus* L. leaves reveals significant antitumor effects in cancers of breast, colorectal, liver and normal cell lines (Rajasekaran et al., 2014). Ethanolic extract of this plant was found to be non-toxic to Wistar albino rats even at high doses of 2000 mg/kg bw (S.B. Mishra et al., 2012). Preclinical trials have shown this plant as a promising candidate for development of some skin care products. However human clinical trial related to any skin disease has not been conducted on this plant.

Anisomeles indica (L.) Kuntze has shown antiinflammatory, antioxidant and antimicrobial properties in the earlier studies (Tables 3 and 4). Methanolic extract and purified ovatodiolide from whole plant of *Anisomeles indica* (L.) Kuntze has shown tyrosinase inhibitory property suggesting that they could be applied as a type of dermatological whitening agent in skin care products (Huang et al., 2012). Ovatodiolide also showed cytotoxicity causing apoptosis in producing reactive oxygen species and down-regulation of FLICE inhibitory prote in leading to cell cycle arrest towards oral squamose cell carcinoma (Hou et al., 2009). It possesses significant antiinflammatory activity by inhibiting the enhanced production of nitric oxide (NO) radicals and pro-inflammatory cytokines (TNF-α and IL-12) induced by LPS/IFN-γ on murine peritoneal macrophages (Hsieh et al., 2008). A study by Hsu et al. (2012a) demonstrated that the hexane extract of this plant can induce apoptosis of FaDu human pharynx squamous cancer cells by down regulating the expressions of Bcl-2 and Bcl-xL proteins, up-regulating the expressions of Bax and Bak proteins, and activating caspase-9 and caspase-3. In another study Hsu et al. (2012b) demonstrated that hexane extract of this plant significantly inhibited migration and invasion of FaDu cells in a dose-dependent manner under non-cytotoxic concentrations by suppressing the expression of metalloproteinase-9 and metalloproteinase-2. Acute oral toxicity study of aerial parts of this plant on Wistar rats showed that ethyl acetate and chloroform extract of this plant is non-toxic even at high doses of 2000 mg/kg bw (Sundriyal et al., 2013). However human clinical trial related to any skin disease has not been conducted on this plant.

Annona squamosa L. has shown wound healing, antiinflammatory, antioxidant and antimicrobial properties in the earlier studies (Tables 3 and 4). Seeds of this plant contain a caustic resin that is a toxic irritant principal and can be used to get rid of hair lice (Perry and Metzger, 1980). A clinical trial showed that the seed and the leaf can treat hair lice with minor side effects or irritation (Puapattanakul, 1980). In unblinded, controlled clinical trial the application of cream based on custard apple seed extract killed $>$ 90% of lice (Tiangda et al., 2000). Crude extract of seeds of this plant was non-toxic at lower dose (300 mg/kg bw) but toxic at higher dose of 2000 mg/kg bw to Wistar rats (Aneela et al., 2011). *Argemone mexicana* L. has shown wound healing, antiinflammatory, antioxidant and antimicrobial properties in the earlier studies (Tables 3 and 4) but it is generally orally toxic (Table 3). However, in the present study seed paste and latex of this plant are reported to be used topically (Table 1). Acetone, methanol, ethanol and aqueous leaf extracts of *Argemone mexicana* L. showed antipseudomonal activity against multidrug resistant *Pseudomonas aeruginosa* isolated from clinical samples (Sahu et al., 2012). Aqueous extract of aerial parts showed anti-parasite activity against the chloroquine resistant K1 strain of *Plasmodium falciparum* with IC_{50} value of 5.89 μg/ml (Schrader et al., 2012). In a randomized, controlled clinical trial 89% patients recovered clinically although parasite clearance was achieved in 9% patients (Schrader et al., 2012). However human clinical trial related to any skin disease has not been conducted on *Annona squamosa* L. and *Argemone mexicana* L.

Azadirachta indica A. Juss. has shown wound healing, antiinflammatory, antioxidant, antimicrobial and tyrosinase inhibitory properties in the earlier studies (Tables 3 and 4). There are large numbers of Ayurvedic skin care products made from this plant available in the market. It is part of polyherbal drug of Goodcare Pharma Pvt. Ltd. made of 3 herbs known as “Neem Guard capsules”, which is used in skin diseases. Clinical study was done on 57 patients with symptoms of skin diseases and this capsules were found to be effective in lowering IgE level in case of skin diseases and was effective in some selective diseases like acne, contact dermatitits, urticaria, allergic dermatitis and wet eczema (Allayurveda.com, 2014). *Azadirachta indica* A. Juss. is also a part of polyherbal Ayurvedic formulation of The Himalaya Drug Company made of 8 herbs known as “Anti-dandruff Hair cream”, which is recommended for the treatment of dandruff. The open, non-comparative, phase III clinical trial of this cream was done on 50 patients to evaluate the clinical efficacy and safety (short- and long-term) of this cream in the management of dandruff (Agarwal et al., 2009). The study observed significant symptomatic and clinical improvement of dandruff in 6 weeks and concluded that this cream is effective and safe in the management of dandruff (Agarwal et al., 2009). *Azadirachta indica* A. Juss. along with 6 other herbs is a part of another Ayurvedic formulation which was tested for treating acne vulgaris (Lalla et al., 2001). A Randomized, double-blind, placebo-controlled Phase II clincial trials were conducted on 53 patients for 4 weeks to test efficacy of this formulations and it was oberved that combination of use of internal and external preparations showed better efficacy as compared to the used of oral formulations alone (Lalla et al., 2001). In a limited clinical trial oral administration of 5 g of an aqueous leaf paste of this plant enabled diabetic patients to reduce their dosages of insulin up to 30 to 50% without a singnificant effect on the blood glucose levels (Shukla et al., 1973). Azadirachtin obtained from *Azadirachta indica* A. Juss. possess anti-tumur properties and has the potential to target NF-κB (Thoh et al., 2010). Nimbolide, another compound derived from leaves and flowers of this plant has shown numerous biological activities including anti-cancer activity (H.G. Kumar et al., 2010).

Bambusa bambos (L.) Voss has shown wound healing, antiinflammatory, antioxidant and antimicrobial properties in the earlier studies (Tables 3 and 4). Acute oral toxicity study on this plant revealed that aqueous extract of leaves of this plant was safe to Swiss albino mice even up to dose of 1000 mg/kg bw (Kundu et al., 2011). *Bauhinia variegata* L. has shown wound healing, antiinflammatory, antioxidant and antimicrobial properties in the earlier studies (Tables 3 and 4). This plant also has trypsin inhibitory properties (de Souza et al., 2005). This plant was non-toxic to experimental animals up to oral dose of 2000 mg/kg bw (Table 3). 3′,4′,5,7-Tetrhydroxy-3-methoxyflavone present in this plant is an

antiinflammatory agent (DNP, 2014). Water fraction of *Bauhinia variegata* L. leaf showed pronounced cytotoxic effect against DU-145, HOP-62, IGR-OV-1, MCF-7 and THP-1 human cancer cell lines with 90–99% cell growth inhibitory activity, whereas ethyl acetate fraction also produced considerable cytotoxicity against MCF-7 and THP-1 cell lines (Mishra et al., 2013). The healing potential of lectin of *Bauhinia variegata* L. and its recombinant isoform was evaluated on mice and study indicated that the lectin and its recombinant isoform possess pro-healing properties and may be employed in the treatment of acute skin wounds (Neto et al., 2011). Ethanolic extract of *Bauhinia variegata* L. has shown potential chemopreventive property against N-nitrosodiethylamine induce liver tumor and human cancer cell lines (Rajkapoor et al., 2006). Chemopreventive potential of bark of this plant against DMBA-induced skin papillomagenesis was studied in mice which showed a significant reduction in the skin tumors in treated animals as compared to the control group of animals (Singh and Kale, 2010). However human clinical trial related to any skin disease has not been conducted on *Bambusa bambos* (L.) Voss and *Bauhinia variegata* L.

Boerhavia diffusa L. has shown antiinflammatory, antioxidant and antimicrobial properties in the earlier studies (Tables 3 and 4). Aqueous extract of leaves of this plant was non-toxic to Wistar albino rats and albino mice even up to dose of 2000 mg/kg bw (Orisakwe et al., 2003). Aqueous methanol extract of *Boerhavia diffusa* L. reduced metastases formation by B167-10 melanoma cells whereas Punarnavine a compound from this plant enhanced immune response against metastatic progress of B16F-10 melanoma cells in mice (Manu and Kuttan, 2007). Clinical trial conducted on 50 patients newly diagnosed with pulmonary tuberculosis showed that clinical recovery rate of patients treated with this plant was faster than in the control (Kant et al., 2001). *Brassica juncea* (L.) Czern. has shown wound healing, antiinflammatory, antioxidant and antimicrobial properties in the earlier studies (Tables 3 and 4). This plant has trypsin inhibitory properties (Mandal et al., 2002). Acute dermal toxicity-fixed study showed that leaf extracts of this plant are non-toxic even at concentration of 2000 mg/kg bw topically (Malan et al., 2011). *Buchanania cochinchinensis* (Lour.) M.R.Almeida has shown wound healing, antiinflammatory, antioxidant and antimicrobial properties in the earlier studies (Tables 3 and 4). Methanolic seed extracts of this plant are non-toxic to Swiss albino mice and Wistar rats even at dose of 2000 mg/kg bw (Warokar et al., 2010; Singh and Bothara, 2012). In a study by Pattnaik et al. (2013), methanolic root extract of *Buchanania cochinchinensis* (Lour.) M.R.Almeida showed significant wound healing potential. Topical application of *Buchanania cochinchinensis* (Lour.) M.R.Almeida (10% w/w) ointment significantly increased (40.84%) the tensile strength in the incision wound model (Pattnaik et al., 2013). However human clinical trials related to any skin disease have not been conducted on *Boerhavia diffusa* L., *Brassica juncea* (L.) Czern. and *Buchanania cochinchinensis* (Lour.) M.R.Almeida.

Butea monosperma (Lam.) Taub. has shown wound healing, antiinflammatory, antioxidant and antimicrobial properties in the earlier studies (Tables 3 and 4). This plant has trypsin inhibitory properties (Pandey and Jamal, 2010). Toxicity study on powder suspension of seeds of this plant on Charles Foster strain albino rats showed that it has toxic effect when administered in powder form (Donga et al., 2011). *Butea monosperma* (Lam.) Taub. is part of topical herbal formulation of The Himalaya Drug Company made of 2 herbs known as “Hair Loss Cream”, which is recommended for preventing hair loss and promoting new growth of hair in men and women. Open, phase IV clinical trial was conducted on 20 patients (15 male and 5 females) age ranging between 21 and 71 years and cream was found to be safe and effective in prevention of hair loss (Ravichandran et al., 2008). *Butea monosperma* (Lam.) Taub. has antiinflammatory (Shahavi and Desai, 2008) and antifungal (Yadava and Tiwari, 2007) activities which could be reason for its efficacy.

Caesulia axillaris Roxb. has shown antioxidant and antimicrobial properties in the earlier studies (Tables 3 and 4). In a toxicological study on mice, LD_{50} value of essential oil of this plant was reported as 9166.6 μl/kg bw (P.K. Mishra et al., 2012). Essential oil of *Caesulia axillaris* Roxb. has exhibited its fungitoxicity against *Aspergillu flavus* at its minimum inhibitory concencration of 1300 mg/L and fungitoxic principle of the oil was standardized as γ-asarone which showed fungitoxicity against the test fungus at 500 mg/L (Varma et al., 2002). However human clinical trial related to any skin disease has not been conducted on this plant. *Callicarpa macrophylla* Vahl has shown antiinflammatory and antimicrobial properties in the earlier studies (Tables 3 and 4). Betulinic acid (BA), a pure compound from *Callicarpa macrophylla* Vahl has been reported to be a selective inducer of apoptosis in tumor cells and it also exhibits antiinflammatory and immunomodulatory properties (Aggarwal et al., 2011). Treatment of cells with Betulinic acid suppressed NF-κB-dependent reporter gene extression and the production of NF-κB-regulated gene products such as COX-2 and MMP-9 induced by inflammatory stimuli (Takada and Aggarwal, 2003). Further preclinical, toxicological and clinical studies are required to assess safety and efficacy of this plant in treatment of skin diseases.

Calotropis procera (Aiton) Dryand. has shown wound healing, antiinflammatory, antioxidant and antimicrobial properties in the earlier studies (Tables 3 and 4). Its milky sap is caustic and irritant on skin and can cause swelling and ulceration (Morton, 1962). Irritant effects were observed in six contact dermatitis patients patch tested with the leaf crushed in normal saline (Singh et al., 1978). Latex of this plant was reported as toxic to black rat (Pahwa and Chatterjee, 1988). In another study it was observed that aqueous extract of root bark of this plant is relatively safe as compared to hydroalcoholic extract of root bark (Ouedraogo et al., 2013). *Calotropis procera* (Aiton) Dryand. along with 21 other plants is part of a polyherbal Ayurvedic formulation of The Himalaya Drug Company known as “Muscle & Joint Rub”. Phase III clinical trial of Muscle & Joint Rub showed that it is effective and safe in the management of muscle sprains, contusions and inflammatory musculoskeletal disorders (Rajanna and Kolhapure, 2005). Anti-inflammatory effect of this plant is known to be caused by inhibiting PGE2 (Arya and Kumar, 2005).

Cannabis sativa L. has shown antiinflammatory, antioxidant, antimicrobial and tyrosinase inhibitory properties in the earlier studies (Tables 3 and 4). Leaf extracts of this plant were non-toxic to female Wistar albino rats even up to dose of 4000 mg/kg bw (Zade et al., 2013), whereas seed oil was toxic to wistar albino rat (Dahab et al., 2013). The dust from the dried fibre may cause irritation and pruritus and its oil can also cause skin infection (Slaviero, 1916; Schwartz et al., 1957). Tetrahydrocanibinol is the compound present in this plant which is toxic to the nervous system (Duke, 2012). There are some biologically active compounds in *Cannabis sativa* L., such as cannabinoids which is antibacterial (Appendino et al., 2008; Radwan et al., 2009) and antifungal (Radwan et al., 2009), cannabinoid ester which is antibacterial as well as antifungal (Ahmed et al., 2008), and cannabidiol has anti-inflammatory properties (BenShabat et al., 2009). *Cassia fistula* L. has shown wound healing, antiinflammatory, antioxidant, antimicrobial and tyrosinase inhibitory properties in the earlier studies (Tables 3 and 4). This plant has trypsin inhibitory properties (Wijaya et al., 2000). Pod pulp, seed extract and stem bark extract of this plant were recorded to be non-toxic to experimental animals (Table 3). A clinical trial was conducted on 81 children aged between 4 and 13 years to assess the laxative effect of *Cassia fistula* L. emulsion (CFE) with mineral oil on

Pediatric functional constipation (FC) and results showed that CFE was most effective in the 3 week treatment of children with FC (Mozaffarpur et al., 2012). Further preclinical, toxicological and clinical studies are required to assess safety and efficacy of this plant in treatment of skin diseases.

Celastrus paniculatus Willd. has shown wound healing, antiinflammatory and antioxidant properties in the earlier studies (Tables 3 and 4). Seed oil is rubefacient (Nadkarni, 1976). Whole plant and seed extracts of this plant were not toxic even at high doses of 2000 and 5000 mg/kg bw, respectively (Table 3). *Celastrus paniculatus* Willd. along with 21 other plants is part of a polyherbal Ayurvedic formulation of The Himalaya Drug Company known as "Muscle & Joint Rub". Phase III clinical trial of Muscle & Joint Rub showed that it is effective and safe in the management of muscle sprains, contusions and inflammatory musculoskeletal disorders (Rajanna and Kolhapure, 2005). Since the studied product was a combination of different plants, it is not clear what effect this plant had on the studied disease. Celastrol, a plant-derived triterpene has antioxidant and antiinflammatory activity and in low nanomolar concentrations celastrol was found to suppress the production by human monocytes and macrophages of the pro-inflammatory cytokines TNF-alpha and IL-1beta (Allison et al., 2001). Additional clinical studies are required before a firm conclusion can be made.

Chrysopogon zizanioides (L.) Roberty has shown antiinflammatory, antioxidant, antimicrobial and tyrosinase inhibitory properties in the earlier studies (Tables 3 and 4). Oil of this plant was found to be non-toxic to albino mice and albino rats with LD_{50} value of 2985.38 mg/kg bw (Tripathi et al., 2006). Its oil can produce dermatitis in hypersensitive individuals (Greenberg and Lester, 1954). *Chrysopogon zizanioides* (L.) Roberty is also a part of polyherbal formulation of The Himalaya Drug Company made of 16 herbs known as "Anti-Wrinkle cream", which is used in management of facial skin wrinkles. Prospective, open, non-comparative, phase III clinical trial was conducted on 25 patients of both sexes, aged from 35 to 65 years with wrinkled facial skin and significant improvement in the facial skin wrinkles after a week's application in almost all persons and no clinically significant adverse reactions were observed (Ravichandran et al., 2005). Oil of *Chrysopogon zizanioides* (L.) Roberty is also a part of polyherbal formulation of The Himalaya Drug Company made of oils of 3 plants known as "Baby Powder", which is used in the management of infantile hyperhidrosis, miliaria rubra, and bad body odor. A prospective clinical trial on 20 infants (birth weight of more than 2500 g) of age 1–12 months suffering from hyperhidrosis, miliaria rubra, and bad body odor showed significant improvement in 3 days time and complete recovery after a week's application confirming that it is clinically effective and safe (Chatterjee et al., 2005a). *Chrysopogon zizanioides* (L.) Roberty oil is also a part of polyherbal formulation of The Himalaya Drug Company made of 5 plants known as "Nourishing Baby Oil", which is used in infantile dry skin. Prospective, open, phase III clinical trial was conducted on infants between 1 and 12 months of age and was found to be effective and safe in infantile xerosis (Chatterjee et al., 2005c; Parthasarthy et al., 2009). *Chrysopogon zizanioides* (L.) Roberty is part of a polyherbal formulation of The Himalaya Drug Company made of 7 herbs known as "Anti-dandruff Shampoo", which is recommended for the treatment of dandruff. Prospective, open, non-comparative, phase III clinical trial was conducted on 35 patients suffering from moderate to severe form of dandruff to evaluate the clinical efficacy and safety (short- and long-term) of the shampoo in the management of dandruff (Ravichandran et al., 2004b). The study observed a significant reduction in the mean scores of itching and white scales of dandruff and subjective evaluation revealed remarkable symptomatic and clinical improvement in 2 weeks period (Ravichandran et al., 2004b). Since all the clinically tested Ayurvedic products were having this plant in combination with other plants it is not clear what effect this plant had on diseases. Additional clinical studies are required before a firm conclusion can be made. The active compounds of *Chrysopogon zizanioides* (L.) Roberty are valencene, 9-octadecenamide, 2,6,10,15,19,23-hexamethyl-2, 6,10,14,18,22-tetracosahexaene, 1,2-benzendicarboxylic acid, di-isooctyl ester and terpenoids such as 3 monoterpenes, 2 sequiterpenes and 1 triterpene (Huang et al., 2004). According to Chatterjee et al. (2005a, 2005b, 2005c), *Chrysopogon zizanioides* (L.) Roberty is a potent emollient and acts as a moisturizing and soothing agent.

Cissampelos pareira L. has shown antiinflammatory, antioxidant and antimicrobial properties in the earlier studies (Tables 3 and 4). Hydroethanolic extract of whole plant was non-toxic to rats even at dose of 2 g/kg bw (Amresh et al., 2008). A clinical trial of *Cissampelos pareira* L. showed anti-dengue activity of its extracts (Bhatnagar et al., 2011). Cycleanine, a compound isolated from *Cissampelos pareira* L. has antiinflammatory properties (DNP, 2014). Isoliquiritigenin, a type of natural phenol isolated from *Cleome viscosa* L. is antitumor promoter, antioxidant, antiinflammatory, antimutagenic and antifungal agent (DNP, 2014) and it is under experimentation phase testing for use as a cancer treatment and as an aide for cocaine addiction. *Cleome viscosa* L. has shown wound healing, antiinflammatory, antioxidant, antimicrobial and tyrosinase inhibitory properties in the earlier studies (Tables 3 and 4). Seeds and leaves have rubefacient and vesicant properties (Chopra and Bhadwar, 1940; Behl et al., 1966), whereas bark is irritant and acrid (Nadkarni, 1976). Ethanolic extract of leaves and whole plant was non-toxic to Wistar albino rats even at dose of 2 g/kg bw (Panduraju et al., 2011). Further clinical tials are needed to assess efficacy of *Cissampelos pareira* L. and *Cleome viscosa* L. to treat any skin disease.

Clerodendrum infortunatum L. has shown antiinflammatory, antioxidant and antimicrobial properties in the earlier studies (Tables 3 and 4). Methanolic extract of leaves of this plant was non-toxic to Swiss albino mice even at dose of 2000 mg/kg bw (Das et al., 2011). A study on anticancer activity of methanol extract of *Clerodendrum infortunatum* L. against Ehrlich's ascites carcinoma (EAC) bearing Swiss albino mice and isolation of bioactive terpenoids from it showed that it has significant anticancer activity, which can be attributed to the presence of oleanolic acid and clerodinin A (Sannigrahi et al., 2012). There is one US patent on this plant, which provides a composition having an extract from *Clerodendrum infortunatum* L., and a method of obtaining the extract, a method of treating cancer by administering a composition having an extract of *Clerodendrum infortunatum* L. to a person in need thereof, a method of activating caspase-3 in a cell by administering a composition having an extract of *Clerodendrum infortunatum* L. to a cell and method of inducing apoptosis in a cell by administering a composition having an extract of *Clerodendrum infortunatum* L. to a cell (Giri et al., 2014). *Commelina benghalensis* L. has shown wound healing, antiinflammatory, antioxidant and antimicrobial properties in the earlier studies (Tables 3 and 4). Hydroethanolic extract of leaves of this plan was non-toxic to Wistar albino female rats even at dose of 2000 mg/kg bw (Tiwari et al., 2013). Human clinical trial related to any skin disease has not been conducted on *Clerodendrum infortunatum* L. and *Commelina benghalensis* L.

Crotalaria juncea L. has shown antiinflammatory, antioxidant and antimicrobial properties in the earlier studies (Tables 3 and 4). Ethanolic extract of leaves of this plant was non-toxic to male albino Wistar rats even at dose of 2000 mg/kg bw (Ashok et al., 2006). *Cryptolepis dubia* (Burm.f.) M.R.Almeida has shown antiinflammatory, antioxidant and antimicrobial properties in the earlier studies (Tables 3 and 4). Whole plant and leaf extracts of this plant

were non-toxic to mice, rat and rabbit (Minh and Tuan, 2013). *Curculigo orchioides* Gaertn. has shown wound healing, antiinflammatory, antioxidant and antimicrobial properties in the earlier studies (Tables 3 and 4). Hydroalcoholic extract of rhizome of this plant was non-toxic to Wistar rats even at dose of 2000 mg/kg bw (Asif and Kumar, 2010). According to Chinese Pharmacopoeia (2010), *Curculigo orchioides* Gaertn. has a certain degree of toxicity, and the clinical dosage recommended for adults is 3–9 g daily. Curculigoside treated human umbilical vein endothelial cell injury induced by H_2O_2 in *in vitro* study with active concentrations of 0.5, 5 and 10 μmol/ml (Wang et al., 2010). However human clinical trial related to any skin disease has not been conducted on *Crotalaria juncea* L., *Cryptolepis dubia* (Burm.f.) M.R.Almeida and *Curculigo orchioides* Gaertn.

Cuscuta reflexa Roxb. has shown antiinflammatory, antioxidant, antimicrobial and tyrosinase inhibitory properties in the earlier studies (Tables 3 and 4). Aqueous and alcoholic extract of stem of this plant was non-toxic to albino mice of both sex even at dose of 2000 mg/kg bw (Katiyar et al., 2012). *Cynodon dactylon* (L.) Pers. has shown wound healing, antiinflammatory, antioxidant and antimicrobial properties in the earlier studies (Tables 3 and 4). Chloroform and ethanolic extracts of whole plant was non-toxic to mice even at dose of 2000 mg/kg bw (Yogesh et al., 2013). *Dalbergia sissoo* DC. has shown antiinflammatory, antioxidant and antimicrobial properties in the earlier studies (Tables 3 and 4). Alcoholic extract of bark of this plant was non-toxic to Wistar rats even at dose of 3000 mg/kg bw (Mojahid-ul-Islam and Elhddad, 2012). Alcohol extract of aerial parts showed dose dependent inhibitory effect on the motility of isolated rabbit duodenum, pronounced bronchodilation, as well as significant antiinflammatory, antipyretic, analgesic and estrogen-like activities (Sarg et al., 1999). However human clinical trial related to any skin disease has not been conducted on *Cuscuta reflexa* Roxb. and *Dalbergia sissoo* DC.

Datura stramonium L. has shown antiinflammatory, antioxidant and antimicrobial properties in the earlier studies (Tables 3 and 4). *Datura stramonium* L. poisoning is very common in India usually involving seeds (Gaire and Subedi, 2013) and symptoms of poisoning include agitation, seizures, blurred vision, dry mouth, delirium, mydriasis, photophobia, extreme thirst, tachycardia, nausea, vomiting, decreased bowel sounds, difficulty in swallowing and speaking, hyperthermia, hypertension, loss of consciousness and coma (Oberndorfer et al., 2002). As per study conducted on male rats by Bouzidi et al. (2011), a single dose of acute toxicity of 100 mg/kg of *Datura stramonium* L. includes decrease in the weight of the liver, spleen and brain and significant increases in the levels of red blood cells (RBC), hematocrit (HCT), hemoglobin (HGB), and white blood cells (WBC). *Dendrophthoe falcata* (L.f.) Ettingsh. has shown antiinflammatory, antioxidant and antimicrobial properties in the earlier studies (Tables 3 and 4). Ethanolic extract of leaves of this plant showed low level of general toxicity with LC_{50} value of 100 μg/ml in Brine shrimp lethality assay for general toxicity on Swiss albino mice of either sex (Hasan et al., 2006). However human clinical trial related to any skin disease has not been conducted on *Datura stramonium* L. and *Dendrophthoe falcata* (L.f.) Ettingsh.

Desmodium gangeticum (L.) DC. has shown antiinflammatory, antioxidant and antimicrobial properties in the earlier studies (Tables 3 and 4). Extracts of aerial parts of this plant were non-toxic to albino Wistar rats even at dose of 2000 mg/kg bw (Bisht and Bhattacharya, 2013). *Desmostachya bipinnata* (L.) Stapf has shown antiinflammatory, antioxidant and antimicrobial properties in the earlier studies (Tables 3 and 4). Alcoholic and aqueous extracts of roots of thid plant were non-toxic to female albino mice even at dose of 2000 mg/kg bw (Hegde et al., 2010). A clinical study of *Desmostachya bipinnata* (L.) Stapf along with *Imperata cylindrica* Beauv., which are part of Trinapanchamoola, a well known diuretic was conducted on 29 healthy volunteers and results showed that use of these herbs leaded to a percentage increase in urine volume as compared to placebo group (N.T. Shah et al., 2012). Different concentrations of 70% methanolic extract of the roots of this plant have shown effective antioxidant activities in different reactive oxygen species scavenging assays including DPPH, nitric oxide, hydrogen peroxide and hydroxyl radical scavenging activities (Rahate et al., 2012). Besides that *in-vitro* cytotoxic study on the human cervical cancer cell lines (HeLa), human laryngeal epithelial carcinoma cells (Hep-2) and BIH 3T3 using 3-(4,5-Dimethylthiazol-2-yl)-2,5-diphenyltetrazolium bromide (MTT) showed inhibition in concentration dependent manner of range between 25 and 400 μg/ml on all the cell lines (Rahate et al., 2012). *Dicliptera paniculata* (Forssk.) I.Darbysh. has shown antiinflammatory and antimicrobial properties in the earlier studies (Tables 3 and 4). Aqueous, methanolic and butanolic extracts of leaves and stem of this plant were non-toxic to Wistar rats even at dose of 5000 mg/kg bw (Abdulazeez et al., 2010). However human clinical trial related to any skin disease has not been conducted on *Desmodium gangeticum* (L.) DC., *Desmostachya bipinnata* (L.) Stapf and *Dicliptera paniculata* (Forssk.) I.Darbysh.

Eclipta prostrata (L.) L. has shown antiinflammatory, antioxidant and antimicrobial properties in the earlier studies (Tables 3 and 4). Ethanolic extract of whole plant was non-toxic to Swiss albino mice and Wistar albino rats even at dose of 4 g/kg bw (Md.A. Rahman et al., 2012). The active compounds of *Eclipta prostrata* (L.) L. are triterpenoid glucosides such as daucosterol, stigmasterol-3-O-glucoside and ecliptasaponin C (Zhang and Chen, 1996), which could be involved in beneficial effects of extract of this plant on skin diseases. Immunomodulatory effect of daucosterol, a beta-sitosterol glycoside, against disseminated candidiasis caused by *Candida albicans* were studied and it was showed that it protects mice against disseminated candidiasis by the CD4+ Th1 immune response (Lee et al., 1997). *Eclipta prostrata* (L.) L. also has potent antiinflammatory (Ferreira et al., 2000), analgesic (Sawant et al., 2004) and immunomodulatory activities (Jaythirtha and Mishra, 2004). Its leaves contain α-terthienyl which is phototoxic to human skin (Gommers and Voor in't Holt, 1976). *Eclipta prostrata* (L.) L. is part of a polyherbal formulation of The Himalaya Drug Company made of 5 herbs known as “Anti-dandruff Hair Oil”, which is recommended for the treatment of dandruff. Open, non-comparative, non-randomized, phase III clinical trial was done on 25 patients of both sexes, from the age group of 20–45 years to evaluate the clinical efficacy and safety (short- and long-term) of this oil in the management of dandruff (Vyjayanthi et al., 2004). The study showed that there was highly significant reduction in the mean score for itching and white scales at the end of 2 weeks and oil is effective and safe in the management of dandruff (Vyjayanthi et al., 2004). Further clinical studies are required to assess efficacy of this plant in treatment of skin diseases.

Ehretia laevis Roxb. has shown antioxidant properties in the earlier studies (Table 3). Further preclinical, toxicological and clinical studies are required to assess safety and efficacy of *Ehretia laevis* Roxb. and *Eulaliopsis binata* (Retz.) C.E.Hubb. in treatment of skin diseases. *Euphorbia hirta* L. has shown wound healing, anti-inflammatory, antioxidant and antimicrobial properties in the earlier studies (Tables 3 and 4). Its sap is described as irritant (Chopra and Bhadwar, 1940; Souder, 1963; Behl et al., 1966). Patch test of crushed leaves of this plant in small quantity of normal saline elicited positive reaction in 2 out of 18 contact dermatitis patients (Singh et al., 1978). Aqueous and ethanolic extracts of fruits suspended in 0.5% w/v Sodium-CMC were found to be toxic to adult Swiss albino mice even at low doses and mortality was observed at high doses of 2500 and 3000 mg/kg bw (P. Das et al., 2010). However human clinical trial related to any skin disease has

not been conducted on this plant. *Euphorbia thymifolia* L. has shown antiinflammatory, antioxidant and antimicrobial properties in the earlier studies (Tables 3 and 4). Its latex is vesicant to the skin of many individuals and can cause dermatitis (Pammel, 1911; Souder, 1963). Alcohol, chloroform and aqueous extracts of whole plant were non-toxic to albino mice even at dose of 2000 mg/kg bw (Mamatha et al., 2014). Clinical trials with triturated fresh leaves of this plant have proved its efficacy in paronychia (common nail bed infection) when applied at early stage (Mali and Panchal, 2013). Further clinical studies are required to assess efficacy of this plant in treatment of skin diseases.

Ficus benghalensis L. has shown wound healing, antiinflammatory, antioxidant and antimicrobial properties in the earlier studies (Tables 3 and 4). Ethanol and aqueous extracts of bark of this plant were non-toxic to female albino Wistar rats even at dose of 2000 mg/kg bw (Garg and Paliwal, 2011). This plant is a part of a polyherbal Ayurvedic formulation of The Himalaya Drug Company made of 7 herbs known as "Anti-dandruff Shampoo", which is recommended for the treatment of dandruff. Prospective, open, non-comparative, phase III clinical trial was conducted on 35 patients suffering from moderate to severe form of dandruff to evaluate the clinical efficacy and safety (short- and long-term) of the shampoo in the management of dandruff (Ravichandran et al., 2004b). The study observed a significant reduction in the mean scores of itching and white scales of dandruff and subjective evaluation revealed remarkable symptomatic and clinical improvement in 2 weeks period (Ravichandran et al., 2004b). The principal compounds of *Ficus benghalensis* L. are ketones such as tetratriacontene, 6-heptatriacontene, pentatriacontan, beta-sitosterol-alpha-D-glucose and meso-inositol (Subramanian and Misra, 1978). *Ficus racemosa* L. has shown wound healing, antiinflammatory, antioxidant, antimicrobial and tyrosinase inhibitory properties in the earlier studies (Tables 3 and 4). Methanolic extract of bark of this plant was non-toxic to female Wistar rats even at dose of 2000 mg/kg bw (Choudhury and Jadhav, 2013). A clinical trial on leaves of *Ficus racemosa* L. showed antihyperglycemic action showing support for the treatment of Type 2 Diabetes Mellitus in traditional system of medicines (Urooj and Ahmed, 2013). Efficacy of a proprietary herbal preparation consisting of *Ficus racemosa* L. and 5 other plants was evaluated on 28 patients of persistent post prandial hyperglycemia, which showed persistant fall in fasting and post prandial blood glucose levels (Dubey et al., 1993). A clinical trial of polyherbal ointment of which *Ficus racemosa* L. was one of the constituents on 15 burn patients showed that ointment is highly efficacious in controlling *Candida albicans* infection and helped in quicker epithelialization and burns were completely healted in 8–26 days of treatment (Bhatt and Kora, 1984). Racemosic acid, a compound from *Ficus racemosa* L. showed potent inhibitory activity against COX-1 and 5-LOX *in vitro* with IC_{50} values of 90 and 18 μM, respectively (Li et al., 2004). Cytotoxic effects of the extracts of *Ficus racemosa* L. were investigated *in vitro* using the ATP-based luminescence assay and results showed no cytotoxicity on the cell lines skin fibroblasts (1BR3), human Caucasian hepatocyte carcinoma (Hep G2) and human Caucasian promyelocytic lekaemia (HL-60) (Li et al., 2004).

Ficus religiosa L. has shown wound healing, antiinflammatory, antioxidant, antimicrobial and tyrosinase inhibitory properties in the earlier studies (Tables 3 and 4). Methanolic extract of bark of this plant was non-toxic to Swiss albino male mice at dose of 500 mg/kg bw (Sreelekshmi et al., 2007). A clinical study of *Ashvattha Kshirpaka* prepared with 10 g powder of root bark, stem bark, fruit and tender leaf buds of *Ficus religiosa* L. on 44 patients erectile dysfunction showed encouraging results (Virani et al., 2010). Bergaptol a compound isolated from *Ficus religiosa* L. has antiinflammatory and antifungal properties (DNP, 2014). *Holarrhena pubescens* Wall. ex G.Don has shown antiinflammatory, antioxidant and antimicrobial properties in the earlier studies (Tables 3 and 4). Stem bark of *Holarrhena pubescens* Wall. ex G.Don is part of an Ayurvedic drug known as Sunder Vati used for treatment of acene vulgaris. *Holarrhena pubescens* Wall. ex G.Don has astringent activity (Nadkarni, 1976). Ethanolic extract of seed of this plant was non-toxic to female Wistar rats even at dose of 2000 mg/kg bw (Saha and Subrahmanyam, 2013). Ranomised, double-blind, placebo-controlled clinical trial of this drug was done on 42 male and 42 female patients between 18 and 28 years and Sunder Vati was found to be orally effective in the treatment of acne vulgaris (Pranjpe and Kulkarni, 1995). A clinical study on stem bark extracts of *Holarrhena pubescens* Wall. ex G.Don in the form of *Kutaja tvak churna* showed healing activity in patients suffering from bleeding piles (Pal et al., 2009). In a clinical study it was observed that a daily intake of the bark powder for 15 days completely cured patients suffering from amebiasis (Shahabuddin et al., 2006).

Holoptelea integrifolia Planch. has shown wound healing, antiinflammatory, antioxidant and antimicrobial properties in the earlier studies (Tables 3 and 4). Methanol and petroleum ether extracts of leaves of this plant were non-toxic to albino mice of either sex even at dose of 2000 mg/kg bw (Sutar et al., 2014). *Hyptis suaveolens* (L.) Poit. has shown wound healing, antiinflammatory, antioxidant and antimicrobial properties in the earlier studies (Tables 3 and 4). This plant also has trypsin inhibitory properties (Aguirre et al., 2004). Extracts of leaves of this plant were non-toxic to Swiss albino mice of either sex and LD_{50} was found to be more than 5000 mg/kg bw (Shenoy et al., 2009b). *Ipomoea carnea* Jacq. has shown wound healing, antiinflammatory, antioxidant and antimicrobial properties in the earlier studies (Tables 3 and 4). Aqueous extract of leaves of this plant showed toxicity symptoms to Wistar albino rats at dose of 2000 mg/kg bw (Khalid et al., 2011). Preliminary clinical trial covering 195 patients of three age groups (70 patients for 15–25 years age, 80 patients of 26–35 years age and 45 patients of 36–50 years age) have confirmend the efficacy of this plant in curing vaginal and cervical leucorrhea, with a success rate of about 76% (Atique et al., 2009). However human clinical trial related to any skin disease has not been conducted on *Holoptelea integrifolia* Planch., *Hyptis suaveolens* (L.) Poit. and *Ipomoea carnea* Jacq.

Lannea coromandelica (Houtt.) Merr. has shown wound healing, antiinflammatory, antioxidant and antimicrobial properties in the earlier studies (Tables 3 and 4). Methanolic extract of bark of this plant was non-toxic to mice even at dose of 1000 mg/kg bw (Majumder et al., 2013). *Lantana camara* L. has shown wound healing, antiinflammatory, antioxidant and antimicrobial properties in the earlier studies (Tables 3 and 4). Contact with this plant can cause dermatitis to some susceptible individuals (Morton, 1962). Methanolic extract of leaves of this plant was non-toxic to adult mice even at dose of 2 g/kg bw (Pour et al., 2011). *Lawsonia inermis* L. has shown wound healing, antiinflammatory, antioxidant, antimicrobial and tyrosinase inhibitory properties in the earlier studies (Tables 3 and 4). This plant also has trypsin inhibitory properties (Yogisha et al., 2002). Ethanolic extract of leaves of this plant was toxic to Wistar albino rats of either sex with toxicity above dose of 1000 mg/kg bw and lethal dose at 2000 mg/kg bw (Kaur et al., 2014). *Leonotis nepetifolia* (L.) R.Br. has shown wound healing, antiinflammatory, antioxidant and antimicrobial properties in the earlier studies (Tables 3 and 4). Trichomes of leaves can cause dermatitis in susceptible individuals (Gowanloch and Brown, 1943). Methanolic extract of stem bark of this plant was non-toxic to Swiss albino mice with LD_{50} value of 3807.9 mg/kg bw (Ayanwuyi et al., 2009). However human clinical trial related to any skin disease has not been conducted on *Lannea coromandelica* (Houtt.) Merr., *Lantana camara* L., *Lawsonia inermis* L. and *Leonotis nepetifolia* (L.) R.Br.

Linum usitatissimum L. has shown wound healing, antiinflammatory, antioxidant and antimicrobial properties in the earlier studies (Tables 3 and 4). This plant also has trypsin inhibitory properties (Cierpicki and Otlewski, 2000). Its oil can produce a follicular eruption (Barnes, 1931) and can be irritant and occasionally sensitizing (Schwartz et al., 1957). Fixed seed oil of this plant was non-toxic to Swiss albino mice of either sex even at dose of 20 ml/kg bw (Kaithwas et al., 2011). It has been found that *Linum usitatissimum* L. seed lignan reduces mammary tumor growth in the later stages of carcinogenesis (Thompson et al., 1996). According to Bommareddy et al. (2009), flaxseed meal and oil are effective chemo-preventive agents. Daily consumption of 50 g flaxseed for four weeks lowers the LDL cholesterol by 8% in young healthy adults (Cunnane et al., 1995). Basing on human trials before 2011 Health Canada's Food Directorate concluded that a claim linking consumption of ground whole flaxseed and blood cholesterol lowering was warranted (Health Canada, 2014; Shim et al., 2014).

Litsea glutinosa (Lour.) C.B.Rob. has shown wound healing, antiinflammatory, antioxidant and antimicrobial properties in the earlier studies (Tables 3 and 4). Aqueous extract of whole plant was non-toxic to Wistar rats even at dose of 2000 mg/kg bw (Devi and Meera, 2010). *Mallotus philippensis* (Lam.) Mull.Arg. has shown antiinflammatory, antioxidant and antimicrobial properties in the earlier studies (Tables 3 and 4). Methanolic extract of leaves of this plant was non-toxic to female mice even at dose of 2000 mg/kg bw (Babu et al., 2010). Rottlerin or mallotoxin, a principal phloroglucinol constituent of this plant appears to have great potential for being used in chemotherapy because it affects several cell machineries involved in survival, apoptosis, autophagy and invasion (Maioli et al., 2012). A clinical trial on 40 patients exhibiting symptoms of parasitic infection was undertaken to assess efficacy of this plant on intestinal parasites and results showed symptomatic relief without any adverse effect (Bharadwaj et al., 2013). *Martynia annua* L. has shown antiinflammatory and antimicrobial properties in the earlier studies (Tables 3 and 4). Methanolic extract of leaves of this plant was non-toxic to Wistar albino rats even at dose of 2000 mg/kg bw (Babu et al., 2010). *Mirabilis jalapa* L. has shown antiinflammatory, antioxidant and antimicrobial properties in the earlier studies (Tables 3 and 4). Hydroethanolic extract of flowers of this plant was non-toxic to female rat even at dose of 2000 mg/kg bw (Augustine et al., 2013). There are trypsin inhibitors present in the seeds of *Mirabilis jalapa* L. (Kowalska et al., 2007). Human clinical trial related to any skin disease has not been conducted on *Litsea glutinosa* (Lour.) C.B.Rob., *Mallotus philippensis* (Lam.) Mull.Arg., *Martynia annua* L., *Millettia extensa* (Benth.) Baker. and *Mirabilis jalapa* L. Pharmacological, toxicological, preclinical and clinical studies are required on *Millettia extensa* (Benth.) Baker to prove its efficacy in treatment of skin diseases.

Mitragyna parvifolia (Roxb.) Korth. has shown antiinflammatory, antioxidant and antimicrobial properties in the earlier studies (Tables 3 and 4). Ethanolic extract of leaves of this plant was non-toxic to Swiss albino mice even at dose of 1500 mg/kg bw (Kaushik et al., 2009a). *Momordica dioica* Roxb. ex Willd. has shown antiinflammatory, antioxidant, antimicrobial and tyrosinase inhibitory properties in the earlier studies (Tables 3 and 4). Aqueous extract of fruits of this plant was non-toxic to Wistar rats even at dose of 15 times more than effective dose *i.e.*, 200 mg/kg bw (R. Singh et al., 2011). *Mucuna pruriens* (L.) DC. has shown wound healing, antiinflammatory, antioxidant and antimicrobial properties in the earlier studies (Tables 3 and 4). This plant also has trypsin inhibitory properties (Prakash et al., 2001). Trichomes on pods of this plant can penetrate skin and cause itching and irritation that may last for some time (Allen, 1943). Active pruritogenic principle in this plant is a proteolytic enzyme, mucunain (Arthur and Shelly, 1955; Shelly and Arthur, 1955). Methanolic extract of seeds of this plant was non-toxic to albino mice of both sexes even at dose of 4000 mg/kg bw (Manalisha and Chandra, 2012). Randomised, controlled, double blind crossover clinical trial of eight Parkinson's disease patients with a short duration L-dopa response and on period dyskinesisa was conducted to assess clinical effects and levodopa (L-dopa) pharmacokinetics following two different doses of *Mucuna pruriens* (L.) DC. preparation (Katzenschlanger et al., 2004). The results showed the rapid onset of action and longer on time without concomitant increase in dyskinesias on mucuna seed powder formulation suggest that this natural source of L-dopa might possess advantages over conventional L-dopa preparations in the long term management of Parkinson's disease (Katzenschlanger et al., 2004). *Nicotiana plumbaginifolia* Viv. has shown antimicrobial properties in the earlier studies (Table 3). However human clinical trial related to any skin disease has not been conducted on *Mitragyna parvifolia* (Roxb.) Korth., *Momordica dioica* Roxb. ex Willd., *Mucuna pruriens* (L.) DC. and *Nicotiana plumbaginifolia* Viv. Pharmacological, toxicological, preclinical and clinical studies are required on *Nicotiana plumbaginifolia* Viv. to prove its efficacy in treatment of skin diseases.

Oroxylum indicum (L.) Kurz has shown wound healing, antiinflammatory, antioxidant and antimicrobial properties in the earlier studies (Tables 3 and 4). Ethanolic extract of roots of this plant was non-toxic to Wistar male albino rats even at dose of 5000 mg/kg bw (Tamboli et al., 2011). Baicalein from *Oroxylum indicum* (L.) Kurz showed anti-cancer potential in leukemia cells through inducing cell cycle arrest and apoptosis (Roy et al., 2007). Two compounds Chrysin and Oroxylin A isolated from *Oroxylum indicum* (L.) Kurz have antiinflammatory properties (DNP, 2014). *Persicaria barbata* (L.) H.Hara has shown antiinflammatory properties in the earlier studies (Tables 3 and 4). Alcoholic extract of leaves of this plant was non-toxic to Wistar albino rats even at dose of 2000 mg/kg bw (Sheela et al., 2011). However clinical trials related to any skin disease has not been conducted on *Oroxylum indicum* (L.) Kurz and *Persicaria barbata* (L.) H.Hara.

Phyllanthus amarus Schumach. and Thonn. has shown wound healing, antiinflammatory, antioxidant and antimicrobial properties in the earlier studies (Tables 3 and 4). Aqueous extract of leaves of this plant was non-toxic to female rats even at dose of 5000 mg/kg bw (Asare et al., 2011). Extract from *Phyllanthus amarus* Schumach. and Thonn. and some purified lignans from this plant such as niranthin, nirtetralin and phyltetralin exhibit *in vivo* and *in vitro* anti-inflammatory properties, which are probably mediated through its direct ability to interact with platelet activating factor receptor binding sites (Kassuya et al., 2006). A clinical trial on 50 patients between 25 and 60 years with hepatitis-C suggested that therapy with *Phyllanthus amarus* Schumach. and Thonn. increased antioxidants and reduced lipid peroxidation of hepatic cellular and intracellular membranes and protected liver damage due to free radicals in hepatitis-C (Nikam et al., 2011). Another clinical trial showed that *Phyllanthus amarus* Schumach. and Thonn. has inhibitory effects on HIV *in vitro* and *in vivo* (Notka et al., 2004). Owing to the impressive preclinical therapeutic potential, the plant extracts have been evaluated in human trial for the treatment of HIV, jaundice, hypertension and diabetes (Patel et al., 2011) where they have show promising properties. However further clinical studies are required to prove its efficacy in treatment of skin diseases.

Pongamia pinnata (L.) Pierre has shown wound healing, antiinflammatory, antioxidant and antimicrobial properties in the earlier studies (Tables 3 and 4). Crude extract of seeds of this plant was non-toxic to Wistar female albino rats even at dose of 2000 mg/kg bw (Aneela et al., 2011). *Pongamia pinnata* (L.) Pierre is part of polyherbal Ayurvedic formulation of The Himalaya Drug Company made of 8 herbs known as “Anti-dandruff Hair cream”. The open, non-comparative, phase III clinical trial of this cream was done on 50 patients to evaluate the clinical efficacy and safety (short- and

long-term) of this cream in the management of dandruff (Agarwal et al., 2009). The study observed significant symptomatic and clinical improvement of dandruff in 6 weeks and concluded that this cream is effective and safe in the management of dandruff (Agarwal et al., 2009). *Ranunculus sceleratus* L. has shown antiinflammatory and antimicrobial properties in the earlier studies (Tables 3 and 4). Fresh plant is intensely irritating and can produce violent blistering, particularly of the lips and tongue, and also of skin (Weber, 1937; Chopra and Bhadwar, 1940). Chloroform, methanol and water extracts of leaves of *Pongamia pinnata* (L.) Pierre and *Ranunculus sceleratus* L. were evaluated for anti-ringworm activity against five strains of dermatophytes *viz*., *Trichophyton rubrum*, *Trichophyton mentagrophytes*, *Trichophyton tonsurans*, *Microsporum gypseum* and *Microsporum fulvum* and chloroform extracts were found to be highly active aginst all the tested fungi (Sharma et al., 2012a). *Premna mollissima* Roth has shown antiinflammatory properties in the earlier studies (Table 4). Methanolic extract of leaves of this plant was non-toxic to albino mice of either sex even at dose of 5000 mg/kg bw (Mahire et al., 2009). However clinical trials related to any skin disease have not been conducted on *Ranunculus sceleratus* L. and *Premna mollissima* Roth.

Rauvolfia serpentina (L.) Benth. ex Kurz has shown antimicrobial properties in the earlier studies (Table 4). Methanolic extract of root of this plant was toxic at high doses to male Wistar albino mice and LD_{50} value was determined as 141.25 mg/kg bw (Azmi and Qureshi, 2012). It is one of the important ingredients of Ayurvedic formulation known as “Divya Muka Vati”, which is used to cure high blood pressure. In a double-blind placebo-controlled investigation, 14 healthy adult male volunteers were studied to assess and compare the urinary effects of acute single doses of two antihypertensive formulations containing *Rauvolfia serpentina* (L.) Benth. ex Kurz and it was observed that even a single dose of these formulations is effective (Leary et al., 1986). Moreover reserpine has shown significant antiinflammatory activity in animal models (Mokhtarian and Griffin, 1984; Lam and Ferrell, 1991).

Ricinus communis L. has shown antiinflammatory, antioxidant and antimicrobial properties in the earlier studies (Tables 3 and 4). Castor oil is said to produce contact dermatitis to some susceptible individual (Karabow, 1927; Coca et al., 1931). Methanolic and aqueous extracts of roots of this plant were non-toxic to Wistar albino rats even at dose of 2000 mg/kg bw (Ilavarasan et al., 2011). In a study on guinea-pig eyelid, ricinolein a compound from this plant showed both pro-inflammatory and antiinflammatory properties that were observed upon acute and repeated application of this compound, respectively (Vieira et al., 2001). *Ricinus communis* L. along with 21 other plants is part of a polyherbal Ayurvedic formulation of The Himalaya Drug Company known as “Muscle & Joint Rub”. Phase III clinical trial of Muscle & Joint Rub showed that it is effective and safe in the management of muscle sprains, contusions and inflammatory musculoskeletal disorders (Rajanna and Kolhapure, 2005).

Scoparia dulcis L. has shown wound healing, antiinflammatory, antioxidant and antimicrobial properties in the earlier studies (Tables 3 and 4). Methanolic extract of whole plant was non-toxic to mice with LD_{50} value of 3807 mg/kg bw (Abdulsalaam et al., 2013). Nishino et al. (1993), reported that Scopadulcic acid B (SDB), a tetracylcic diterpenoid isolted from this plant inhibited the effects of tumor promoter 12-O-tetradecanoylphorbol-13-acetate *in vitro* and *in vivo*, and potency of Scopadulcic acid B was proved to be stronger than that of other natural antitumor-promoting terpenoids, such as glycyrrhetinic acid. SDB has shown antiviral activity against Herpes simplex virus type 1, antitumor activity in various human cell lines and direct inhibitory activity against porcin gastric (H+), K(+)-ATPase (Riel et al., 2002). *Semecarpus anacardium* L.f. has shown antiinflammatory, antioxidant and antimicrobial properties in the earlier studies (Tables 3 and 4). Dermatitis may be caused to some susceptible individuals by contact with timber of this plant (Hausen, 1973). Milk preparation of nuts of this plant was non-toxic to Wistar male albino rats even at dose of 2000 mg/kg bw (Vijayalakshmi et al., 2000). 3-Pentadecyl-1,2-benzenediol isolated from this plant is antibacterial agent and cytotoxic to human cancer lines (DNP, 2014). A variety of nut extract preparations of this plant are effective against many diseases, *viz*., arthritis, tumors, infections etc. and are non-toxic even at high dose of 2000 mg/kg (Premalatha, 2000).

Senna tora (L.) Roxb. has shown wound healing, antiinflammatory, antioxidant and antimicrobial properties in the earlier studies (Tables 3 and 4). This plant also has trypsin inhibitory properties (Tripathi et al., 2011). Ethanolic extract of leaves of this plant was non-toxic to Swiss albino mice of both sexes even at a high dose of 10,000 mg/kg bw (Ambali et al., 2005). Antisporiatic activity of three flavonoids, namely luteolin-7-O-β-glucopyranoside, quercetin-3-O-β-D-glucuronide and formononetin-7-O-β-D-glucoside isolated from the ethanol extract of leaves were investigated using UV-B induced photodermatitis model on healthy male Wistar rats (120–170 g) and Swiss albino mice (25–30 g) by Vijayalakshmi and Geetha (2014). The ethanolic extract (400 mg/kg) and three flavonoids exhibited a significant percentage reduction of relative epidermal thickness when compared with a positive control, and study concluded that the flavonoids from *Senna tora* (L.) Roxb. leaves have significant antipsoriatic activity (Vijayalakshmi and Geetha, 2014).

Sesamum indicum L. has shown antiinflammatory, antioxidant and tyrosinase inhibitory properties in the earlier studies (Tables 3 and 4). Seed oil of this plant was non-toxic up to oral dose of 3 g/kg bw to Swiss albino mice (Ambali et al., 2005). The randomized clinical trial on 41 patients with type 2 diabetes showed that *Sesamum indicum* L. seeds have favorable effects in decreasing cardiovascular disease risk factors in Type 2 diabetic patients (Mirmiran et al., 2013), whereas a controlled open-label clinical trial on effect of defatted *Sesamum indicum* L. seeds on type 2 diabetic women has showed glycemic control and weight in diabetic women by use of defatted *Sesamum indicum* L. seeds (Figueiredo, Modesto-Filho, 2008). *Sesamum indicum* L. is also a part of polyherbal Ayurvedic formulation of The Himalaya Drug Company made of 8 herbs known as “Anti-dandruff Hair cream”. The open, non-comparative, phase III clinical trial of this cream was done on 50 patients to evaluate the clinical efficacy and safety (short- and long-term) of this cream in the management of dandruff (Agarwal et al., 2009). The study observed significant symptomatic and clinical improvement of dandruff in 6 weeks and concluded that this cream is effective and safe in the management of dandruff (Agarwal et al., 2009). *Sesamum indicum* L. is rich source of linolenic acid, sesamol (475 mg/100 g), a potent natural antioxidant, and alpha-tocopherol (32 mg/100 g), the most active form of vitamin E (Hahm et al., 2009), which may be main reason for the beneficial effect of oil of this plant on treating skin diseases.

Shorea robusta Gaertn. has shown wound healing, antiinflammatory and antimicrobial properties in the earlier studies (Tables 3 and 4). Aqueous and methanolic extracts of leaves of this plant were non-toxic to Swiss albino mice and male wistar rats with orally fed LD_{50} values of 2.4 g/kg and 2.7 g/kg bw, respectively (Chattopadhyay et al., 2012). A study by Chattopadhyay et al. (2012) showed that aqueous extract of leaves of this plant at 40 μg/ml significantly inhibited NO_2, and release of prostaglandin E_2, tumor necrosis factor-α, interleukins-1β and interleukin-6 from lipopolysaccharide-stimulated human monocytic cell lines suggesting mechanism of action of anti-inflammatory property of this plant. It is a part of polyherbal formulation of The Himalaya Drug Company made of 4 herbs known as “FootCare Cream”, which is used in management of facial skin wrinkles. Prospective, open, non-comparative, phase III clinical trial

was conducted on 50 patients with mean age of 44.26 years and significant reduction in number of cracks and other symptoms such as scaling, pruritus, wrinkles, pain, pigmentation and laxity of skin was seen (Dange and Grandhi, 2009). Since the studied product was polyherbal formulation, it is not clear what effect exactly *Shorea robusta* Gaertn. had on the studied disease. Alopecia affects 20% of men and has an androgenic etiology in 95% of cases, *i.e.* high testosterone concentration and a high rate of conversion to DHT by 5-α-reductase (Mas-Chamberlin et al., 2005). Oleanolic acid is the prime alkaloids present in *Shorea robusta* Gaertn. (Dange and Grandhi, 2009). The oleanolic acid is shown to inhibit 5-α-reductase with a dose effect enabling inactivation of 54% of testosterone conversion to dihydrotestosterone at a concentration as low as 9 ppm (Mas-Chamberlin et al., 2005). Chebulinic acid present in seed of this plant is antioxidant compound (DNP, 2014). Further clinical trials are needed to assess efficacy of this plant in the treatment of skin diseases.

Sida cordata (Burm. F.) Borss. Waalk. has shown antioxidant properties in the earlier studies (Table 4). *Sida rhombifolia* L. has shown antiinflammatory and antioxidant properties in the earlier studies (Tables 3 and 4). Aqueous root extract of this plant was non-toxic even up to dose of 5000 mg/kg bw in acute oral toxicity test conducted on Sprague-Dawley rats (Indhumathi et al., 2014). *Solanum incanum* L. roots are pounded and applied topically on leucoderma by the Tharu community. Ethanolic fruit extracts of this plant has not shown toxicity even up to dose of 2000 mg/kg bw in acute oral toxicity test on female swiss albino mice (Indhumathi et al., 2014). A study by Wu et al. (2011) on topical treatment of SR-T100 extracted from *Solanum incanum* L. on UVB-induced cutaneous squamouse cell carcinoma (SCC) of hairless mice and actinic keratoses of human, indicated that SR-T100 induces apoptosis of SCC cells *via* death receptors and the mitochondrial death pathway. The high efficiency of SR-T100 in this preclinical trial suggested that SR-T100 is a highly promising herb for actinic keratoses of human and related disorders (Wu et al., 2011). Clinical trials related to any skin disease have not been conducted on *Sida cordata* (Burm. F.) Borss. Waalk, *Sida rhombifolia* L. and *Solanum incanum* L., and there is need for further preclinical, toxicological and clinical studies on these plants to prove scientific basis for use of these plants in treatment of skin diseases.

Terminalia arjuna (Roxb. ex DC.) Wight & Arn. has shown wound healing, antiinflammatory, antioxidant and antimicrobial properties in the earlier studies (Tables 3 and 4). *Terminalia arjuna* (Roxb. ex DC.) Wight & Arn. also has trypsin inhibitory properties (Rai et al., 2008). In a study on male swiss albino mice, methanolic extract of leaves of this plant was found to be non-toxic with LD_{50} value of 900 mg/kg bw (Biswas et al., 2011a). Several clinical studies have assessed efficacy of *Terminalia arjuna* (Roxb. ex DC.) Wight & Arn. in cardiac disorders (Paarakh, 2010). In a clinical study this plant has shown to decrease platelet activation which shows its antithrombotic properties (Malik et al., 2009). In a clinical study on 20 patients of angiographically proven coronary artery diseases, ethanolic bark extract of *Terminalia arjuna* (Roxb. ex DC.) Wight & Arn. decreased platelet activation suggesting that it possess anthithromic properties (Malik et al., 2009). *Terminalia arjuna* (Roxb. ex DC.) Wight & Arn. along with 6 other herbs is a part of Ayurvedic formulations which were tested for treating acne vulgaris (Lalla et al., 2001). A Randomized, double-blind, placebo-controlled Phase II clincial trials were conducted on 53 patients for 4 weeks to test efficacy of these formulations and it was oberved that combination of use of internal and external preparations showed better efficacy as compared to the used of oral formulations alone (Lalla et al., 2001). Since the product studied was a combination of different plants, it is not clear what exact effect *Terminalia arjuna* (Roxb. ex DC.) Wight & Arn. had on the studied disease but positive effect of the studied formulation could be due to synergistic effect of all the 6 herbs used in it. Although preclinical trials have shown this plant is promising candidate for development of skin care products but additional human clinical trials are required before moving any further in that direction.

Tridax procumbens (L.) L. has shown wound healing, antiinflammatory, antioxidant and antimicrobial properties in the earlier studies (Tables 3 and 4). The methanol extract of this plant exhibited high antifungal activity against clinically important human skin pathogens such as *Microsporum fulvum*, *Microsporum gypseum*, *Trichophyton mentagrophytes*, *Trichophyton rubrum*, *Trichosporon beigelii* and *Candida albicans* with low MIC values and GC–MS analysis revealed the presence of 9,12-octadecadienoic acid ethyl ester, 5α-cholestane, hexadecanoic acid ethyl ester and 9-octadecenoic acid ethyl ester as major constituents (Policegoudra et al., 2014). In a study on Swiss albino mice and albino rats, ethyl acetate extract of leaves of this plant showed no toxicity with LD_{50} value of 2100 mg/kg bw (Abubakar et al., 2012). *Typha domingensis* Pers. has shown antiinflammatory and antioxidant properties in the earlier studies (Tables 3 and 4). *Vallaris solanacea* (Roth) Kuntze has shown antiinflammatory, antioxidant and antimicrobial properties in the earlier studies (Tables 3 and 4). Root bark oil extract of this plant was found to be non-toxic to albino rats at concentration of 5 ml/kg bw (Punam et al., 2012). Clinical trials related to any skin disease have not been conducted on *Typha domingensis* Pers. and *Vallaris solanacea* (Roth) Kuntze, and further toxicological, preclinical and chemical studies are required on these plants to identify active compounds in these plants and their efficacy in treatment of skin diseases.

Vanda tessellata (Roxb.) Hook. ex G.Don. has shown antiinflammatory and antimicrobial properties in the earlier studies (Tables 3 and 4). Alcoholic and aqueous extracts of whole plant were found to be non-toxic even up to 2 g/kg bw in a study on Swiss mice (Kumar et al., 2000). Topical application of extract of *Vanda tessellata* (Roxb.) Hook. ex G.Don. to rats at a dose of 150 mg/kg/day for 10 days showed wound healing properties in excision wound model (Nayak et al., 2005). *Vanda tessellata* (Roxb.) Hook. ex G.Don. along with 21 other plants is part of a polyherbal Ayurvedic formulation of The Himalaya Drug Company known as "Muscle & Joint Rub". Phase III clinical trial of Muscle & Joint Rub showed that it is effective and safe in the management of muscle sprains, contusions and inflammatory musculoskeletal disorders (Rajanna and Kolhapure, 2005). Since the studied product was combination of different plants, it is not clear what exact effect *Vanda tessellata* (Roxb.) Hook. ex G.Don. had on the studied disease. Additional human clinical studies are required to assess efficacy of this plant in treating skin diseases.

Verbascum thapsus L. has shown antiinflammatory and antioxidant properties in the earlier studies (Tables 3 and 4). Woolly leaves of this plant are generally irritant to skin of some susceptible individuals (White, 1887). Aqueous extract of leaves of this plant was tested for toxicity in Brine Shrimp and radish seed bioassays and extract showed toxicity at higher doses (around 1000 mg/L) with LC_{50} of < 1000 mg/L (Turker and Camper, 2002). Verbascoside compound present in *Verbascum thapsus* L. has proven antiinflammatory action (Speranza et al., 2009) and 11,13 (18)-Oleanadiene-3,16,23,28-tetrol compound present in this plant has antiinflammatory properties (DNP, 2014). Clinical trials on 171 children aged 5–18 years have shown that *Verbascum thapsus* L. significantly improve ear pain associated with Otitis Media when treated with the infusion (Sarrell et al., 2003). *Verbascum thapsus* L. has also shown positive anti-tubercular properties in clinical trials (Carthy and Mahony, 2011). Cinical trials related to any skin disease have not been conducted on this plant.

Vitex negundo L. has shown wound healing, antiinflammatory, antioxidant, antimicrobial and tyrosinase inhibitory properties in the earlier studies (Tables 3 and 4). It has also shown trypsin

inhibitory properties (Gacche et al., 2008). Oil of this plant was non-toxic with LD_{50} value of over 2000 mg/kg (Chattopadhyay et al., 2014) and had some important antifungal, antibacterial and antioxidant compounds (DNP, 2014) (Tables 3 and 4). The flavonoid-rich fraction (5,7,3′-trihydroxy, 6,8,4′-trimethoxy flavones) of *Vitex negundo* L. was found to antagonize the androgenic action of testosterone propionate on the male reproductive system of castrated prepubertal and intact adult dog (Bhargava, 1989). The principal compounds of *Vitex negundo* L. are flavone vitexcarpin (Diaz et al., 2003), nedundins A and B, diasyringaresinol, lyoniresinol, vitrofolal E and F (Azhar-Ul-Haq et al., 2004), 6-phenyldihydronaphthalene-type lignan, vitedoin A, phenyl naphthalene-type ligand alkaloide, vitedoamine A, trinorlabdane-type diterpene and vitedoin (Ono et al., 2004). Mature leaves of *Vitex negundo* L. were found to have antihistaminic, membrane stabilizing, anti-inflammatory, analgesic (possibly mediated *via* prostaglandin synthesis inhibition) astringent and antioxidant activities (Dharmasiri et al., 2003). There are many polyherbal Ayurvedic skin care products with *Vitex negundo* L. in market. Extract of *Vitex negundo* L. is part of polyherbal formulation of The Himalaya Drug Company made of 4 herbs known as “Acne-N-Pimple Cream” recommended for the management of acne vulgaris. Phase III clinical trial of this cream on 26 patients suffering from acne vulgaris showed that application of cream reduced number of blackheads and whiteheads, in number of inflamed pustules and overall inflammation (Ravichandran et al., 2004a). *Vitex negundo* L. oil is one of the key ingredients of polyherbal “antiseptic cream” of The Himalaya Drug Company used for treatment of cuts, wounds, burns, rashes, sores and fungal skin infections. Open clinical trial of this cream was conducted on 50 patients in the age group of 20 to 50 years and study showed that this cream accelerated the rate of healing, reduced pus and odor from wounds, removed necrosis and inflammation, reduced wound size and prevented hypertrophic scarring (Indra Kumar, 2002). Oil of *Vitex negundo* L. is part of another polyherbal formulation of The Himalaya Drug Company made of 4 herbs known as “Diaper Rash Cream” recommended for the management of Infantile Irritant Diaper Dermatitis (IIDD). A prospective phase III clinical trial on 15 infants (birth weight of more than 2500 g) suffering from IIDD showed complete recovery from the clinical manifestations of IIDD, after a week's application (Chatterjee et al., 2005b). *Vitex negundo* L. contains Casticin, isoorientin, chrysophenol D, luteolin, p-hydroxybenzoic acid and D-fructose, which have anti-inflammatory and analgesic activities and it also contains bioflavonoids, which act through inhibition of prostaglandin biosynthesis resulting in both central and peripheral analgesic action (Telang et al., 1999). *Vitex negundo* L. along with 21 other plants is part of a polyherbal Ayurvedic formulation of The Himalaya Drug Company known as “Muscle & Joint Rub”. Phase III clinical trial of Muscle & Joint Rub showed that it is effective and safe in the management of muscle sprains, contusions and inflammatory musculoskeletal disorders (Rajanna and Kolhapure, 2005). Water extract in combination with matra basti as 500 mg tablets showed relief from signs and symptoms of sciatica *i.e.*, pain, weakness, numbness, and other discomforts in clinical studies on 119 patients in the age group of 20–60 years (Ali et al., 2010). A clinical trial of external (massage for 30 minutes) application of Nirgundi taila (*Vitex negundo* L. oil) was conducted on 40 children suffering from Saisaveeyavata (Poliomyelitis) and was found that it is effective in management of Poliomyelitis (Nair et al., 1988). Vitexins from this plant have cytotoxic effect on various types of cancer cell lines and also have antitumor activity on tumor xenograft models including breast, prostate, liver and cervical cancers (Zhou et al., 2009).

Wrightia arborea (Dennst.) Mabb. has shown wound healing, antiinflammatory, antioxidant and antimicrobial properties in the earlier studies (Tables 3 and 4). Methanolic extract of leaves of this plant was found to be non-toxic even at high dose of 2000 mg/kg bw in acute oral toxicity study on albino rats (Nahar et al., 2013). A clinical study was conducted to evaluate the efficacy of coconut oil extract of *Wrightia arborea* (Dennst.) Mabb. leaves on psoriasis patients with complaints of erythema, scaling, itching, dryness and roughness of skin as well as cracks, fissures and pain in palms and soles and results indicated a definite relief to the patients due to the indigenous drug by improving the clinical symptoms of disease (Kharmawphlang and Sarma, 2003). This is one of the potential plants for the development of skin care products in future. However, further clinical studies humans are required to assess its efficacy.

Ziziphus nummularia (Burm. f.) Wight & Arn. has shown wound healing, antiinflammatory, antioxidant and antimicrobial properties in the earlier studies (Tables 3 and 4). Cyclopeptide alkaloids isolated from the leaves of this plant are potent and efficacious analgesic agent and analgesic activity of these alkaloids is mediated by the peripheral as well as central pathways (Goyal et al., 2013). In acute oral toxicity study, LD_{50} value of cyclopeptide alkaloids fraction was reported as 200 mg/kg bw and CNS depression and reduction in locomotor activity in mice treated with 200 and 300 mg/kg bw was observed (Goyal et al., 2013). However clinical trials related to any skin disease have not been conducted on this plant.

4. Conclusions

Medicinal plants and their traditional formulations have always been a part of social life of Tharu community, which have proved to be very useful in tackling various health related issues along with their key role in curing different skin diseases. The present study has revealed significant information on various medicinal plants used to treat skin diseases by Tharu community. Literature review has confirmed most of the claims made by the Tharu community regarding treatment of various skin diseases by the reported plants. Ayurveda is one of the most ancient medical traditions practiced in India, Sri Lanka and other South Asian countries and its literature describes over 200 herbs, minerals and fats to maintain and enhance the health and beauty of the skin (Datta et al., 2011). Some of the plants reported in the present study are also used in Ayurvedic system of medicine for treatment of various skin problems *viz.*, *Calotropis procera* (Aiton) Dryand., *Azadirachta indica* A. Juss., *Brassica juncea* (L.) Czern., *Buchanania cochinchinensis* (Lour.) M.R.Almeida, *Butea monosperma* (Lam.) Taub., *Eclipta prostrata* (L.) L., *Euphorbia thymifolia* L., *Lawsonia inermis* L., *Mallotus philippensis* (Lam.) Mull.Arg., *Senna tora* (L.) Roxb., *Sesamum indicum* L. and *Shorea robusta* Gaertn. Information on use of these plants to treat skin problems is given in Dravyaguna Vijnana, section of Ayurveda dealing with drug sources, which is more than 1000 years old knowledge. Clinical trials conducted on polyherbal preparations made from these plants have shown their efficacy in treating various skin diseases, which has been discussed in detail in Section 3.2. Review of literature revealed that these are the most explored plants in the earlier pharmacological and clinical studies and some commercial skin care products based on these plants are already available in market.

Various tests on traditional medicinal plants show the effectiveness of traditional herbs against micro-organisms and turn into the bases of contemporary medicine (Evans et al., 2002). Literature review revealed that most of these plants have shown positive antimicrobial properties against wide spectrum of bacteria and fungi in earlier studies. Besides that most of the recorded plant species have shown antiinflammatory activities in the experimental animal models (Table 4). Further microbiological and antiinflammatory studies are recommended on the remaining plants to assess their antimicrobial and antiinflammatory properties. These plants can be evaluated in future studies for their skin care related activities. It is assumed that plants rich in ample

variety of secondary metabolites or phytochemicals, such as tannins, flavanoids, terpenoids, alkaloids, polyphenols are generally superior in their antimicrobial activities (Cowan, 1999; Maiyo et al., 2010). It can be observed in Table 4 that most of the recorded plants are rich in these secondary metabolites, which may have imparted them these positive antimicrobial properties. Information about the important compound isolated from the recorded plants, which have shown proven biological activity (*i.e.*, Phytoalexin, antioxidant, antitumor, antibacterial, anti-inflammatory, antimicrobial, antifungal, antiviral and cytotoxic) have been given in Table 4, which will help in understanding reasons for efficacy of these plants in treatment of skin diseases. Generally it has been suggested that many herbal medicines have very effective wound healing properties because they encourage the repair mechanisms in the natural way (Shenoy et al., 2009a). In many studies, the formulations prepared using natural active ingredients showed therapeutic activity similar to the synthetic drugs and were effective for antibacterial and wound healing activity (Dhanekula et al., 2013).

Some of the plants reported in the present study have shown oral toxicity in earlier toxicological studies *viz*., *Annona squamosa* L., *Argemone mexicana* L., *Azadirachta indica* A. Juss., *Butea monosperma* (Lam.) Taub., *Calotropis procera* (Aiton) Dryand., *Cannabis sativa* L., *Datura stramonium* L., *Euphorbia hirta* L., *Ipomoea carnea* Jacq., *Lawsonia inermis* L., *Rauvolfia serpentina* (L.) Benth. ex Kurz and *Ricinus communis* L. Except *Azadirachta indica* A. Juss. all the other plants which have shown oral toxicity were used topically for treatment of skin diseases by the studied community. In case of *Azadirachta indica* A. Juss, stem bark is toxic at higher concentrations, but leaves are generally non-toxic which were used internally by the Tharu community for treatment of body infection.

Malanogenesis plays an important role in protecting the skin from sun-related injuries and is principally responsible for skin color, but at the same time abnormal hyperpigmentation such as freckles, chloasma, and lentigines can be serious esthetic problems (Han et al., 2012). Tyrosinases are widely used to regulate hyperpigmentation in cosmetic industry as it is one of the major targets in screening inhibitors of melanin synthesis (Nagarani et al., 2014). Flavonoid derived compounds are competitive inhibitors of tyrosinase substrates (Jeong et al., 2009). Besides that compounds having higher antioxidant activity and radical scavenging ability may be linked with tyrosinase inhibitory effects (Peng et al., 2013). Some of the plants reported in the present study have shown tyrosinase inhibitory properties (Table 3) *viz*., *Allium cepa* L., *Anisomeles indica* (L.) Kuntze, *Azadirachta indica* A. Juss., *Cannabis sativa* L., *Cassia fistula* L., *Chrysopogon zizanioides* (L.) Roberty, *Cleome viscosa* L., *Cuscuta reflexa* Roxb., *Ficus racemosa* L., *Ficus religiosa* L., *Lawsonia inermis* L., *Momordica dioica* Roxb. ex Willd., *Sesamum indicum* L. and *Vitex negundo* L. Trypsin inhibitors have important role in skin care. Some of the recorded plants have trypsin inhibitory properties *viz*., *Achyranthes aspera* L., *Allium cepa* L., *Albizia lebbeck* (L.) Benth., *Bauhinia variegata* L., *Brassica juncea* (L.) Czern., *Butea monosperma* (Lam.) Taub., *Cassia fistula* L., *Hyptis suaveolens* (L.) Poit., *Lawsonia inermis* L., *Linum usitatissimum* L., *Mirabilis jalapa* L., *Mucuna pruriens* (L.) DC., *Senna tora* (L.) Roxb., *Terminalia arjuna* (Roxb. ex DC.) Wight & Arn. and *Vitex negundo* L. Some of these plants can also be targeted for development of new skin care products.

The literature review and discussion on the reported plants in Section 3.2 has revealed that products from very few of the reported plants are available in market, while most of the reported plants are still under preclinical or clinical trials. There are various known phytochemicals and antibiotic, antibacterial, antiviral and antifungal agents present in these plants which may be synthesized or transformed to make pharmaceuticals. Some of the reported plants have shown promising results in preclinical trails and there is a need of clinical trials to see their safety and efficacy in treating various skin diseases. These plants may be targeted for development of new medicines, ointments or drugs for the treatment of skin diseases. However further toxicological, preclinical and clinical studies are needed to validate claims about little worked out plant species reported in the present study *viz*., *Sida cordata* (Burm. F.) Borss. Waalk., *Millettia extensa* (Benth.) Baker, *Caesulia axillaris* Roxb., *Ehretia laevis* Roxb., *Vanda tessellate* (Roxb.) Hook. Ex G.Don. and *Eualaliopsis binata* (Retz.) C.E. Hubb. Further studies on these plants are recommended to assess their potential in development of new skin care products.

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